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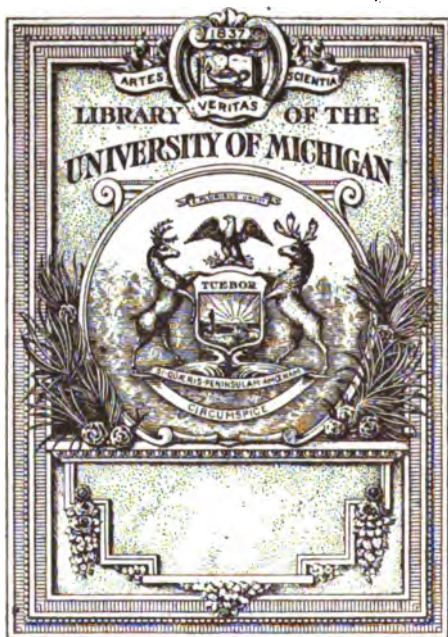
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Across the Great Saint Bernard

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Across the Great Saint Bernard.

The Modes of Nature and the Manners
of Man.

BY
A. R. SENNETT,
A.M.I.C.E., M.I.M.E., M.I.E.E.

AUTHOR OF
"GARDEN CITIES IN THEORY AND PRACTICE," "FRAGMENTS FROM CONTINENTAL
JOURNEYS," "A GLIMPSE OF FAIR ITALIA," "CARRIAGES WITHOUT
HORSES SHALL GO," "THE PETROL CARRIAGE," "HORSELESS
ROAD LOCOMOTION," ETC.

WITH ORIGINAL DRAWINGS BY HAROLD PERCIVAL
AND
NEARLY TWO HUNDRED ILLUSTRATIONS.

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PREFATORY NOTE

It is usual to write something in the nature of a preface, also something by way of apology. As to the former, we feel in this case it would serve no useful purpose; as to the latter, we find we have none to offer beyond the hope that this little work may, in some small measure, add to the pleasure of those who love to roam 'mid mountain snows, make companionship with roaring torrents, and tread in sweet tranquillity the flower-enamelled zones of the glorious Alps, if not in fact, at least in fancy.

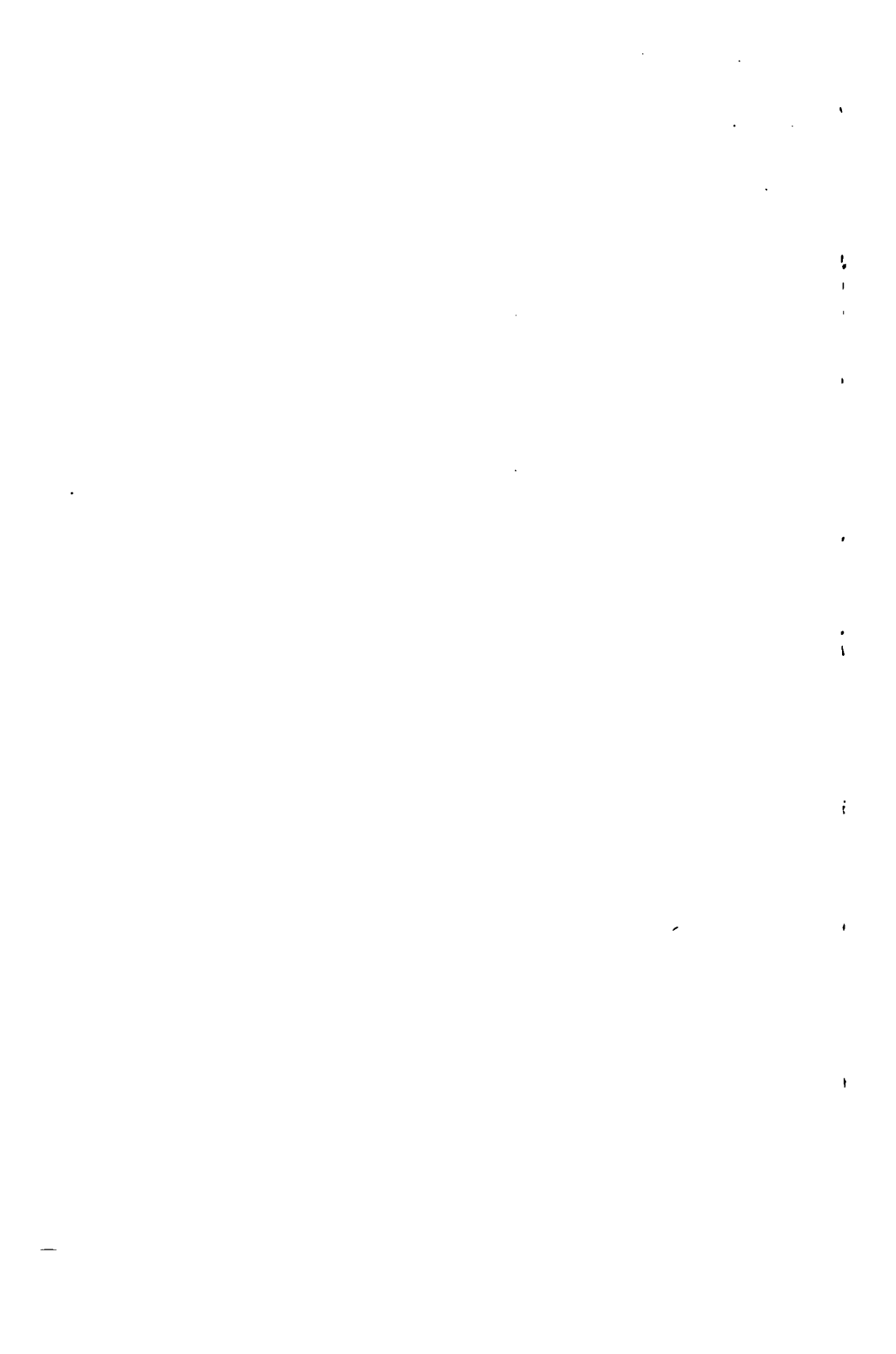
A. R. S.

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To face Chap. R.

THE MONASTIC CONCERT.

CHAPTER I

TOWARDS THE MOUNTAIN CHAIN

"Still Fancy wafts me on, deceived I stand
Estrang'd, adventurous on a foreign land!
Wide and more wide extends the scene unknown,
Where shall I turn, a wanderer, and alone?"*



I.

GENEVA as our headquarters, we had made many mountain excursions awheel, which, from the point of view of the ordinary cyclist, may have been very unsuited to that mode of travel, and we had just, by the same means — our docile mount — crossed the *Tête Noire* and *Forclaz* and descended into

this straggling little town of Martigny.

* Richard Savage.

TOWARDS THE MOUNTAIN CHAIN

Our companions, who had journeyed by carriage, had left us the previous evening to follow the Valley of the Rhone, to be pleasantly led by it back to the endmost shores of blue Lemane—our starting-point.

We, however, having more time at our disposal, had elected to go elsewhere—but where? Where should we turn, a wanderer, and alone?

The weather was gloriously bright, cold, and crisp, and we felt we would like to journey towards somewhere and something even more exhilarating, and if possible savoured with a spice of romance. What more could we wish than that which was near at hand—the Pass of the Great St. Bernard?

That pass, albeit neither the loftiest nor the grandest—though perhaps the most romantic—the most frequently associated with the thought of that glorious mountain crescent which so conspicuously throws its rugged arc across the face of Europe.

The Alps! How familiar is the word, though how inadequate to so majestic a chain! And how misplaced, since it were more properly applied to designate those cool and verdant pastures—tiny oases—entrapped within the frowning wrinkles of the stern and arid mountain rock.

Mountains, to many, are veritable loadstones: what magnets are they not to the man of science! What mounts of freedom are they not to the over-wrought and fagged brain-worker! Lovely though

THE ALPS

the vales may be, those are to be excused who evince impetuosity to desert them and hurry towards the mountain chain, there to find a cleft by which they may scale and cross the barrier.

To such a cleft, indeed, the little town in which we now stand owes its origin, for was not Martigny the *Octodurus* of the Romans?

We have elsewhere* referred to the importance, splendour, and luxury of the Roman capital of Aventicum, with its colosseum, its temples, and its baths for Roman Emperors—a metropolis of Vespasian and Titus; but now the quaint and sleepy Avenches of the Swiss, perched upon its little monticle hard by the calm waters of the Lake of Morat.

The Swiss of yet earlier days were the Celts, the warlike Helvetii, yet they, in B.C. 58, went down before the conquerors of Europe. We have also spoken of ancient Aosta† and the bloody combats there, and have said that where the Roman rode his roads did follow—if, indeed, they preceded him not. Now, to journey from *Aosta* to *Aventia*, he chose to avail himself of the cleft he found upon the mountain brow, wherein now stands the hospice of St. Bernard.

True, the weather was cold enough down here in the valley, and that the temperature would fall

* “Fragments of Continental Journeyings.”

† “A Glimpse of Fair Italia.”

MARTIGNY

inversely as we rose towards St. Bernard's arid shoulders we knew. But what does your cyclist care about the cold if only his road be good?—and here one has before one eight-and-twenty miles of it, all good, and all collar-work to keep one warm. Moreover, scale the brusque Alpine ridge and you are on the skirts of fair Italia, genial and sunny.

Lovers of the mountains, moreover, find little to interest them in this portion of the Rhone Valley, for it is precisely here where the Upper Valasian Valley, in a brusque turn—almost at right angles—debouches upon a flat, monotonous—we had almost said dreary—valley bottom, made, moreover, the less interesting by the existence of one of those straight white roads, more common in France, stretching away along the valley bottom, and further disfiguring it by presenting a regimental array of equally-spaced, ungainly poplars—fit companions of the larch telegraph-poles planted with like precision beside the rectilinear railway.

Quickly, then, we turned our handle bar, and steering westwards, over the bumpy cobble stones of the little town—round, smooth, slippery, and horribly bone-shaking—began at once to ascend gradually on entering the *Val de Drance*. We are soon passing through a suburb of Martigny, with crooked streets and more cobbles, and then we are upon the road again, winding and rising—Alpwards.

After passing through Martigny-le-Bourg we

SEMBRANCHER

cross the river *Drance** where just beyond diverges the Chamounix road, down which we come after crossing the *Tête Noir*. We follow the valley of the Drance, through the little villages of *Brocard* and *Borgeau*—leaving that of *La Croix* half a mile to our right—to *Les Valettes*.† Here we may take the road to the right up to the entrance of the gorge of the *Durnant*, a rocky defile down which the river is precipitated in no less than fourteen falls. This interesting aquatic display is accessible by a wooden gallery half a mile in length.

Coming back to *Les Valettes*, we go on to *Bouvernier*; here the river, which we cross, is in a wooded and rock-bestrewn gorge, and half an hour brings us to the *Galerie de la Monnaie*—a tunnel 70 yards long—near which are



II.

the ruins of an ancient monastery. Again crossing the river, we enter *Sembrancher*; here is a ruined castle and the juncture of the two Drances.

We stop to refresh ourselves with a “cup of coffee,” but the cup comes in the form of a large basin. It was very good, though, and as we sat at

* A mile and a half.

† Three miles.

ORSIÈRES

one side of the narrow, rough-paven street, with its tall houses and their green jalousies, we felt it must be a kind of *avant-coureur* of what we were to see more of on the other side of the pass ; for Sembrancher is Italian of aspect.

Still rising, and twice crossing the river in the next half-hour, we find ourselves at *Orsières*, with its curious old tower. The church of *Orsières* appears to be many sizes too large for the town ; it also appears to be quite new, but, nevertheless, it is well worth going into. It consists of a nave and two side-aisles, the roof being supported upon very massive cylindrical columns. The altar is in excellent taste, and consists of five niches, the centre one containing the crucifix, and the others saints. We sought out the old *curé*, who lives at the back of the church, and amongst other things he told us that the funds for the construction came from the treasury of the Monastery of Great St. Bernard. One of the stained glass windows, by the way, is dedicated to that saint.

Leaving *Orsières*, we commence one of those serpentine ascents peculiar to Switzerland, and from this is obtained a most delightful view of the Valley of the Drance. Looking in a northerly direction, one sees as a thin gray line the tortuous road over which we have already come. Below us is *Orsières*, its mass of wood-shingled roofs packed so tightly together that it would appear to be a streetless

MOTHER EARTH'S HANDMAIDENS

town—which indeed it is—for surely the narrow passages between the houses, across which *vis-à-vis* neighbours might almost shake hands, can scarcely be dubbed streets. The valley is^t a fertile one, and the patches of tilled land are so small that it has the appearance of having been laid out in English allotment gardens. Above these are the closely packed pines, and above, again, the rocky summits upon which no vegetation can thrive. The vale would be quiet indeed were it not that a constant and drowsy roar comes up eternally from the tumbling river, waging war with its obstructive rocky boulders. Here we notice the horses are few but the mules are many; we also notice that these Swiss mules do not like cyclists.

As we sit here far up above the cultivated fields, listening to the tinkling cow-bells, to the jingle of the plough-chains, to the Switzer's gruff call to his oxen, and watch the slowly-moving plough-team gradually ribbing the brown earth, the chain-harrow carefully combing it here, the bush-harrow smoothly brushing the green velvet there, the old women carefully removing every stone and speck yonder, and the children picking off every fallen branchlet, we appreciate how right regally Dame Nature is tended by her men and women in waiting upon her. We feel, moreover, that the occupation is by no means degrading, and one honoured above all others by age.

ANCIENT MEASURES

Few studies are more fascinating than the tracing up of this waiting upon Mother Earth from time immemorial, and the indications of old customs and modes of life entailed. Lubbock tells us that—

“In many of our midland and northern counties most of the meadows lie in parallel undulations, or ‘rigs.’ These are generally about a furlong (220 yards) in length, and either one or two poles ($5\frac{1}{2}$ or 11 yards) in breadth. They seldom run straight, but tend to curve towards the left. At each end of the field a bank, locally called a balk, sometimes 3 or 4 feet high, runs at right angles to the rigs. The fields were originally common, and for fairness of division were arranged in strips or rigs, no man being allowed two contiguous rigs. These arrangements carry us back to the old tenures and archaic cultivation of land, and to a period when the fields were not in pasture, but were arable.

“They also explain our curious system of land measurement. The acre is the amount which a team of oxen were supposed to plough in a day. It corresponds to the German *morgen* and the French *journée*. It was fixed by the ordinance of Edward I. as a furlong in length and four poles in breadth. The furlong or ‘furrow-long’ is the distance which a team of oxen can plough conveniently without stopping to rest. Oxen, as we know, were driven, not with a whip, but with a goad, or pole, the most convenient length for which was $16\frac{1}{2}$ feet,

ANCIENT MEASURES

and the ancient ploughman also used his 'pole' or 'perch' as a measure by placing it at right angles to his first furrow, thus marking off the amount he had to plough. Hence our pole or perch of $16\frac{1}{2}$ feet, which at first sight seems a very singular unit to have selected. This width is also convenient both for turning the plough and for sowing. Hence the most convenient unit of land for arable purposes was a furlong in length and a perch or pole in width.

"The team generally consisted of eight oxen. Few peasants, however, possessed a whole team, several generally joining together and dividing the produce. Hence we often find eight rigs, one for each ox. Often, however, there are ten instead of eight—one being for the parson's tithe, the other tenth going to the ploughman.

"When eight oxen were employed, the goad would not, of course, reach the leaders, which were guided by a man who walked on the near side. On arriving at the end of each furrow he turned them round, and as it was easier to pull than to push them, this gradually gave the furrow a turn towards the left, thus accounting for the slight curvature.* Lastly, while the oxen rested on arriving at the end of the furrow, the ploughman scraped off the earth which had accumulated on the coulter and plough-

* The fact that we usually walk in a curve towards the left, the right leg being the stronger, may also have affected this.

RURAL LIFE

share, and the accumulation of these scrapings gradually formed the balk."

In rural occupation there is nothing mean and debasing, says Washington Irving. "It leads a man forth among scenes of natural grandeur and beauty; it leaves him to the workings of his own mind, operated upon by the purest and most elevating of external influences. Such a man may be simple and rough, but he cannot be vulgar. The man of refinement, therefore, finds nothing revolting in an intercourse with the lower orders in rural life as he does when he casually mingles with the lower orders of cities. He lays aside his distance and reserve, and is glad to waive the distinctions of rank, and to enter into the honest, heartfelt enjoyments of common life. Indeed, the very amusements of the country bring men more and more together, and the sounds of hound and horn blend all feelings into harmony. I believe this is one great reason why the nobility and gentry are more popular among the inferior orders in England than they are in any other country, and why the latter have endured so many excessive pressures and extremities without repining more generally at the unequal distribution of fortune and privilege."

"To this mingling of cultivated and rustic society may also be attributed the rural feeling that runs through British literature, the frequent use of illustrations from rural life, those incomparable descrip-

RURAL LIFE

tions of Nature that abound in the British poets, that have continued down from 'The Flower and the Leaf'* of Chaucer, and have brought into our closets all the freshness and fragrance of the dewy landscape. The pastoral writers of other countries appear as if they had paid Nature an occasional visit and become acquainted with her general charms; but the British poets have lived and revelled with her; they have wooed her in her most secret haunts; they have watched her minutest caprices. A spray could not tremble in the breeze, a leaf could not rustle to the ground, a diamond drop could not patter in the stream, a fragrance could not exhale from the humble violet nor a daisy unfold its crimson tints to the morning, but it has been noticed by these impassioned and delicate observers and wrought up into some beautiful morality.

"The effect of this devotion of elegant minds to rural occupations has been wonderful on the face of the country. A great part of the island is rather level, and would be monotonous were it not for the charms of culture; but it is studded and gemmed, as it were, with castles and palaces, and embroidered with parks and gardens. It does not abound in

* "The Flower and the Leaf" is an allegory, probably written by Chaucer to celebrate the marriage of Philippa, John of Gaunt's daughter, with John, King of Portugal. The poem contains many curious and beautiful passages.

RURAL LIFE

grand and sublime prospects, but rather in little home-scenes or rural repose and sheltered quiet. Every antique farmhouse and moss-grown cottage is a picture, and as the roads are continually winding, and the view is shut in by groves and hedges, the eye is delighted by a continual succession of small landscapes of captivating loveliness.

“The great charm, however, is the moral feeling that seems to pervade it. It is associated in the mind with ideas of order, of quiet, of sober, well-established principles, of hoary usage and reverend custom. Everything seems to be the growth of ages of regular and peaceful existence. The old church of remote architecture, with its low, massive portal, its Gothic tower, its windows rich with tracery and painted glass, in scrupulous preservation, its stately monuments of warriors and worthies of the olden times, ancestors of the present lords of the soil, its tombstones, recording successive generations of sturdy yeomanry, whose progeny still plough the same fields and kneel at the same altar; the parsonage, a quaint, irregular pile, partly antiquated, but repaired and altered in the tastes of various ages and occupants; the stile and footpath leading from the churchyard across pleasant fields and along shady hedgerows, according to an immemorial right of way; the neighbouring village with its venerable cottages, its public green sheltered by trees, under which the forefathers of the present race have

EXPECTATION

sported ; the antique family mansion standing apart in some little rural domain, but looking down with a protecting air on the surrounding scene—all these common features of English landscape evince a calm and settled security and hereditary transmission of home-bred virtues and local attachments, that speak deeply and touchingly for the moral character of the nation."

As we sit up here, high above the peaceful valley, glad to get a breathing spell and a pleasant rest—
• for we have been rising ever since we left Martigny—and watch the drowsily-working attendants upon Mother Earth, our thoughts revert to the pastoral scenes of our own country, so beautifully portrayed in the words we have quoted. But our lingering regrets at our absence from them cease when we turn our eyes towards the majestic mountain chain.

"With what an awful grace yon dome of snow
Ascends, and, swelling, grows upon our sight,
White as an infant's spirit, or the might
Of gray hairs in a monarch !"

Moreover, they are outbalanced by the on-drawing influence, the vivid expectation, of viewing Nature in more majestic mood, as well as of seeing all that is familiar to us differently enacted by the inhabitants of a different land. Each and every occupation and custom we shall see presented to us in a quaint and novel garb, staged amid scenery as entrancing

SYMPATHETIC UNISON

as it is unfamiliar, bosomed 'mid mountains in comparison with which the kindly excrescences, the loved hills of our own land, are pigmy indeed.

Having sauntered in the characteristic Alpine villages, threaded our way through gorge and pass—amused in the one, entranced in the other—we shall mount the Alpine chain which the while has looked down upon us, and whilst in the former we shall be reminded at every turn of our sojourn in a foreign land, we shall, on scaling the summits of the latter, feel that we are veritably in another world.

Indeed, if Dame Nature should herself have embued within us that much-to-be-desired and pleasure-imparting appreciation—have attuned us, moreover, to that harmonious chord in sympathetic unison with her own, when of grandest *timbre*, when her *Klangfabre* is most enchaining and awe-inspiring—then shall we find it difficult to tear ourselves away, by day or by night, from the potent influence of these “silent-watching mountains.” It is with indescribable elation we appreciate that we are nearing the mountain chain, that before and

“ Above us are the *Alps*,
The palaces of Nature, whose vast walls
Have pinnaced in clouds their snowy scalps
And throned eternity in icy halls
Of cold sublimity, where forms and falls
The avalanche, the thunderbolt of snow !
All that expands the spirit, yet appals,

MOUNTAINS BY MOONLIGHT

Gather around these summits, as to show
How Earth may pierce to Heaven, yet leave vain Man
below !”*

After a day spent in exploring a giant glacier, in blundering over its rock-bestrewn moraines in heavy Alpine boots, clambering over its great boulders, then, with feet swathed in *gletscher* socks, noiselessly, and with all the care and skill we can command, scaling the asperse and glissant *seracs*, the blue and acute ridges skirting profound crevasses, where a false step would launch us into eternity, we know not of a more fitting termination to the day, a more awe-inspiring climax after an hour or two of repose in one's hut, than to return to view the colossal ice-field, the slowly-creeping destroyer, by night.

As a potently working spell we can commend a glacial visit at that hour when

“The silver-clouded east reveals
The midnight spectre of the moon.”

If the giant mountains are impressive by day, what are they not by night—glorious, resplendent, silver-moonlight night! If the glaciers—those vast isthmuses of solid ice connecting skies to valleys, so gashed, so pinnacled, so ponderous, so irresistible, with such prepollence entrancingly declaring themselves, in their tortuous and spiny

* Byron.

MOUNTAINS BY MOONLIGHT

forms sculptured in ice, the prototypes of their surrounding valleys and mountains—rivet our admiration by day, then will they enchain us spellbound by night.

Words, we fear, are quite useless; one must come here to gaze upon them in the moonbeams; then may we appreciate in their true majesty our huge near companions the mountains, there close beside us, cleaving the surge of heights, and

“Gleaming, like ghosts of worlds, that interchange
Oracles mightier than Dodona’s wood.”

Their pure white mantles, of royal ermine, trailing far down into the valley, are specked with the black tails of pitchy clefts and crevasses, such clothing but adding to the impressiveness of their royal might and austere majesty. The wind is coming across these vast snow-fields cold as it is pure; it brings water into our eyes, which we have continuously to brush away as we gaze entranced upwards towards the proud white crests, illumined in chill, resplendent, holy argent.

“On this bleak height tall firs, with ice-work crowned,
Bend, while their flaky winter shades the ground!
Hoarse, and direct, a blustering north wind blows!
On boughs, thick rustling, crack the crisped snows!
And tangled frost half frights the wilder’d eye.”

It is probably because the wild and unfamiliar scene “half frights the wilder’d eye”—thus merging

MOUNTAINS BY MOONLIGHT

awe with admiration—that our emotions are so potently wrought upon as we stand here, high above the workaday world, its turmoil and deception, surveying another world spread around us in virgin whiteness, in snowy purity, undefiled by the touch of man, where strength and integrity of purpose is written upon every crag and rocky bastion ; where the loud voice of the avalanche, the shouting of the lithic cascade, the hollow gurglings of subglacial waters, tell of toilers sincere and conscientious ; where the falling snow, the melting ice, the creeping glacier display noiselessly performed operations in an enchanted laboratorium ; where the silence and purity of Nature mocketh querulous and degraded man.

Entrancing, unfamiliar, beauteous indeed is the scene around us here when

“ the moon,
Her silver beams, the snow-mantled tops
Of yonder mountains with a silver hue
Faint tinges, one expanded sheet of light
Diffusing : while the shades, from rock to rock
Irregularly thrown, with solemn gloom
Diversify the whole.”

Let us not, however, be content to stop at the glacier's margin, nor alone to clamber among its lithic playthings strewn upon its fringe, for there among its detritus and devastation, in shadow of but one of its myriad monticles, its mighty billows, struck solid

THE CHILL GLETCHER

by a mystic hand, we shall be depressed by our own insignificance. Nay! let us with rope and ladder bridge the profound crevasse, scale the glissant *serac*, and forge onwards until we find ourselves launched well upon the vast frozen sea.

Out there upon its dumb and heaveless waves we experience a strange excelsior thrill at this wondrous icy expanse—a thrill, however, modified by the stern solemnity of the silent steel-hued scene; so that we are glad again to escape across its boulder-covered shores, its rock-strewn beach. Let us now climb high up the mountain shoulders, to gaze down upon

“This glacier stream compact of welded snows,
A flowing solid of translucent ice,
Extended in the moonshine silently,
A charmed frost-dragon in steel-gleaming scales.”

He looks cold, rugged, and delicious in sunlight, but cold, dreary, and awe-inspiring in this weird moonlight. His thousand cracks and crevasses are not now gently graded in azure light from white lips to dark throats; their edges are sharp, dark, and defined; they stand out black against white, like a thousand doors all leading to eternity. The wind, gently hissing in the pines below, moans as it rolls over these open throats like cross-blown pipes of Pan, whilst every now and again a sudden noise is heard as if the python ice-trunk were turning in its rocky grave.

SNOW FAYS AND FAIRIES

Were our minds tainted by superstition, we would turn our back upon this chill glacier and on such a scene of grim and silent solemnity, and hurry earthwards; but those who go forth with open and unbiassed mind to seek mental nourishment mid mountain and glacier are not superstitious: 'twere too incongruous.

Nevertheless, we feel it requires no vivid imagination to people this great gray ice expanse, so tortuous and asperse, with little, slyly-creeping hobgoblins, with gliding gnomes, with dancing fays and skipping sprites, with fair wand-waving fairies; to feel indeed that

“Here in cool grot and icy cell
The glacier fays and fairies dwell.”

If they inhabit there, they are surely astir now, for night is the time of their nocturnal *al-fresco* revels. On such a glorious moonlit night as this, how could they lie quiescent in their beauteous crystal ice-caves? Here is a habitation and a playground sacred to them alone.

“The cloud may sail there,
Day may flow there,
And the eagle fly,
Haze overshadow
A smooth snow meadow,
And gleams of silver
Fleeting fly
From yon cloud-delver
Of gleaming eye!

THE FAIRY QUEEN

The moon may tarry with
Her pale bow,
And moonrise marry with
Virgin snow,
Blue heavens abide,
Or solemn-eyed
Stars by night, who gaze and go :
Ah ! ne'er pollute
With a mortal fool
Yon realms of *spirits aerial*."*

We think we see them there, their entrancing, diaphanous, beauteous forms gliding o'er the frigid carpeting, passing and repassing the chill portals of those ice-palaces. Yonder is the abode of their queen, the vanguard of whose fairy retinue this moment issues from the dark-mouthed cave we can plainly see now, and which we shall enter to-morrow, when the fairies shall have departed, leaving it illumined by their magic lamp, diffusing that glacial refulgence of inexpressible ethereal azure.

Now emerges the Queen Fairy, a beauteous radiance suffusing her sweet face, softening the calm, e'en cold, dignity of her expression. Her carriage is of graceful hauteur as she glidingly advances, looking so beautiful, so resplendent, in her long and flowing mantle of sheeny blue, edged with ermine fur of snow, sparkling with a rich embroidery of iridescent arabesques, for it is

* Roden Noel.

THE FAIRY'S SUITE

patterned with icy sequins studded profusely with many-faceted, flashing and scintillating, Nature-cut gems of purest crystal. Her lengthy train is edged with a glittering fringe of pointed icicles. Her hair is of shimmering, silvery blonde, and we see the ravishing ripples lighted up by the bright moon, and glinting as it waves. Her eyes are as blue as the glacial crevasse. The hem of her mantle is held by tiny pages, so ethereal that, though their wings are light and translucent as those of the exquisite dragon-fly, they seem scarce to use either these or their tiny feet as they noiselessly glide in air behind their royal mistress, a yard above the snow floor. She is followed by a numerous retinue of retainers, all dressed in a steely blue, again subdued beneath a flowing gossamer of hoary texture, all so *légère*, all with small but beauteous wings, all gliding forward so gradually, so noiselessly, with such little assistance from their feet, that crests and recesses, huge and gaping crevasses, crossed by man by day with rope and ladder and arduous exertion, are skimmed o'er in gliding, kite-like gyration.

We wonder why she has come out in state and with such a gorgeous suite, so we watch her wind her way, slow and stately, far up between the brusque towers, the graceful minarets, the pointed and massy cupolas—pinnacles of her ice-palaces, between the crystal campaniles of her cathedrals, beneath triumphal arches of the glacier thorough-

THE FAIRY DANCE

fares. Still she glides upwards, until now she is in the broad plateau between the hips of the silently-watching mountains.

Now we see why she has come : it is to witness the midnight dance, the fairy revels. That smooth expanse of virgin snow, its soft carpet glistening with myriad diamonds, flashing in the éclat of the bright moonlight, is the glissant dancing-floor of her thousand courtier fays. Her ballroom, with its star-studded canopy, is brightly lighted, and we might compare it to a limelit stage were it not that the glorious moonlight, albeit so brilliant, is so exquisitely suffused over all the stern though beauteous surroundings that the cunning of the scenic mechanician palls before it.

“ Play of a tender light and shade,
On hallowed ground
Dance with the sound
Fairy horns have faintly made ;
A cloud of snow
Softly below
On the blue verge of the form so white.”

There, as soon as the Queen arrives—commencing with a low, studied, slow, and gracefully-recovered courtesy—her fairy host, cavalier fays pairing with courtly *elfen*, merge into an andante movement, producing an entrancing, harmonic, and synchronous whole. Now they converge to form a lovely centre-figure of exquisite pattern ; now, with a grace of

FAIRY CLOUDS

movement as wondrous in its manœuvre as in its silence, they disperse, only to spread over the icy plateau a vast embroidery of chaste design, formed of their own azure selves worked out upon the snowy flooring.

As the dances proceeded, beauteous clouds hovered and gyrated, with constant mutation of form, just above the dancers; and as each figure was set, each arabesque transiently depicted, the clouds descended momentarily upon the actors. These clouds were of exquisite beauty and of ever-changing hue, usually of a gloriously delicate bluish-green, whilst, as their soft and fleecy folds seethed and tumbled amongst themselves, they changed in depth of colouring, often at their fringes approaching to pure whiteness, incessantly glinting with surpassing brilliancy as they rolled and billowed in the bright moonbeams.

It was not for some time that we realized these clouds were animated; they were, indeed, myriad flocks of liliputian flying sprites; the glorious scintillations were but the reflections from their brightly-burnished, lacelike wings. But why, ever and anon, did they descend upon the momentarily quiescent fairy dancers? It was to impart kisses upon those snowy brows—to the chagrin of the suitors, doubtless; sprites were ever mischief-minded—and then again to soar above in grateful, graceful ecstasy.

THE FAIRY ORCHESTRA

But see, a change is taking place ! All this has been performed within a vast *ceinture* of happy, rotund, smiling gnomes, a great orchestral cordon, all playing upon instruments quaintly fashioned and of weird melody—transparent cymbals, silver-like lutes, icy horns, and trumpets. We see no conductor, and none is needed. All are led by some occult synchronizing spell.

But now *accellerando* is the motif. The *légère* feet, the gossamer wings, accelerate, fleet motions become fleet, gyrations become whirls, clouds of powder-snow arise, and, lo ! the dancers' feet forsake the earth, the whole courtly train circumgyrate, always ascending, until in their myriads they form a single beauteous, flocculent cone, rising higher and yet higher till it emulates the noble Eiger. But see ! the apex circumfuses, its azure fringe surges back as a pure white, cloud-like annulus. See yet again ! something steely azure, with exquisite grace of ascent, appears above the snowy crater. Behold, it is the Fairy Queen !

Quite unattended she rises—in silent, solemn, beauteous majesty. What a lovely vision ! How long will it last ? She soars yet upward above the mountain's shadow, till now, for an instant, she is illumined with a ruddy glow o'erpowering to view. The sun has kissed her !—there, far up above the sleeping earth—and we know that his golden corona has shown above the mountain-tossed horizon.

DAWN

Alas! it is the fatal signal; for, as the pricking of a glorious bubble, the vision has vanished into space—into imponderable, ethereal, incomprehensible space.

But, ugh! how bitterly cold it is! and we have been dozing. We hasten to scan the vast, soft dancing-floor, but never a footprint have they left upon that virgin breast to be seen by the eye of mortal. Yet list: the Queen Fairy speaks by the imaginative lips of the lordly bard:

“Where the moon riseth broad and round and bright,
Here on snows, where never human foot
Of common mortal trod, we nightly tread,
And leave no traces o’er the savage sea,
The glassy ocean of the mountain ice;
We skim its ragged breakers, which put on
The aspect of a tumbling tempest’s foam,
Frozen in a moment—a dead whirlpool’s image.
And this most steep fantastic pinnacle,
The fretwork of some earthquake—where the clouds
Pause to repose themselves in passing by—
Is sacred to *our* revels and *our* vigils.”

The “flight of time” is never more thoroughly appreciated than by the occupied and ardent brain-worker or by the interested wanderer “among mountain summits.” Here have we been taking a glance at a giant glacier lying at our feet. Short indeed has the time appeared, yet the Alpine night has sped. We raise our eyes from the great gray-white expanse, only to see that—

BOURG ST. PIERRE

“The stars die out, and the moon grows dim,
Slowly, softly, the darkness paling !

* * * * *

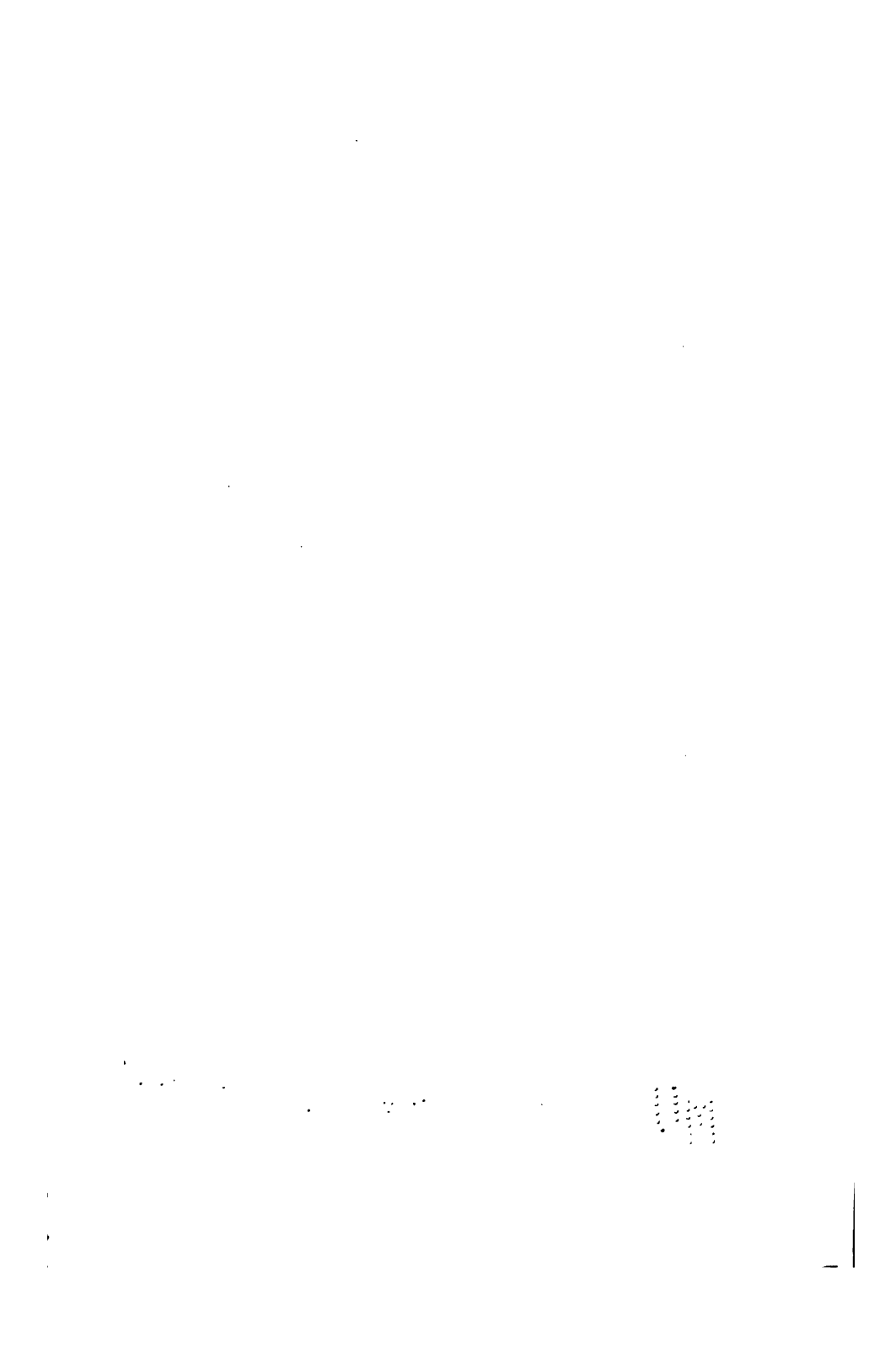
Slowly, softly, a bright unveiling.
The full moon sinking in the west : a beam
Uprising from the orient skies.”

This glorious and ruddy awakening in the orient
skies is our signal for departure. Well and happily
could we spend night after night amid these health-
imparting summits, but now

“Through the hushed pines, beside the hurrying stream,
Must we downward fare, while bells of dawning rise
From unseen hamlets, and beyond our eyes
The solid world looms like a twilight dream
High up in heaven above the unfading snow.”

But whilst we have been ruminating and dreaming
we have also been laboriously pedalling.

Another five miles—always collar work—and we
are passing through the village, of some size, of
Liddes. Beyond this we pass the Chapel of
St. Etienne, cross the brook of that name, pass the
Chapel of *Notre Dame de Lorette*, on our left the
quaint shapen and stately *Mevignier* (11,403 feet),
and in about four miles—which, however, take us a
good round hour—we come into sight of the little
Bourg St. Pierre, standing quite at the foot of the
pass, and are not sorry to make the acquaintance of
Mme. Moret, obliging hostess of the queer little
hotel, “*Au Déjeuner de Napoléon premier.*”





To JOHN CHAP. II.

DAME NATURE'S PAINTERS.



CHAPTER II

DAME NATURE'S PAINTERS

“Meek dwellers 'mid yon terror-stricken cliffs,
With brows so pure, and incense-breathing lips,
Whence are ye?”



III.

WE have time for a stroll round before dinner, and ask the landlady for the key of the *Linnæa*, a Government botanical station,* situated on a conical monticle, once the site of the old Castle of Quart. Then we seek out one of the brothers Balley, and he takes us round and explains some of Flora's Alpine wonders, presenting us with a small piece of the much sought-for edelweiss (*Leontopodium Alpinum*), the lion-footed gnaphalium.

It is almost needless to say that the edelweiss is not growing here, as its place of natural selection, its haunt—as every Alpine climber knows—is far above this altitude, far removed from all verdant

* The Director is Mons. H. Cheeron, Planpalais, Geneva.

THE LINNÆA

vegetation, and, as he knows also, in the most craggy and inaccessible of positions. Thither has the hardy Switzer sought the retiring and snow-loving flower ; there has he with

“ Fearless head and steady foot
Tracked the cradle of its root,
Now a link in friendship’s chain
From the mountain to the main.”*

In placing the little flower of modest hue within the folds of our pocket-book, we must confess to having experienced a feeling of iconoclasm, and we still feel it somewhat of a sacrilege to pluck this typical Alpine plant, except in cases where it may be found in abundance and an ample number of roots be left: for such beauty as it possesses is dimmed by severance from its Alpine environment, whilst to acclimatize it amongst us would appear hopeless.

“ Little flower, if I bear
Thee from this thy mountain air,
Bid thee 'neath our mists and gloom
Open out thy tender bloom,
Wilt thou strive with us to live,
Foreign land thy fragrance give ?
I would fain to England bring
Tokens of the Alpine spring.
Ah ! can I for thee secure
Breath of heaven so fresh and pure ?

* Oscar Browning.

THE EDELWEISS

No, I will not bear thee home ;
Rather let me forth and roam
To the Alps in search of thee."*

To the lover of Nature it were indeed an exquisite and exhilarating pleasure to hie, not alone to the Alps, but far above them in search of this particular meek dweller mid those "terror-stricken cliffs." Here, far up above the zone of ordinary vegetative companionship, we shall still find the edelweiss in that chill realm where Nature's painters would seem to have almost abandoned their joy-inparting labours—that drear altitude where

"Gleam and gloom with varying sway
Has stained their petals ashen gray."

But who *are* the painters Dame Nature employs ? Who is it that paints and embellishes the varied wares she so beneficently displays ? Nay, more ! who keeps it all in perfect decorative repair ?

Nature knows not decay, as Art may do ; what men call her decay is but entrancing transmutation. Yet e'en in such *quasi* "decay" her painters fail not, neither do her pigments for a single hour deteriorate. Some might say that autumn is the decay of summer, yet did ever the inanimate painters of a summer landscape paint anything comparable in bounteous variety—aye, e'en in vividness—with her autumnal "decay" ? Nature's artists in colour

* Beatrix L. Tollemache.

TASTE FOR FLOWERS

stop only where she in her organic self succumbs. Brave is the fight she makes to keep life within her far up upon the mountain's brow, and e'en there her artists attend her, though their vitality be sapped, their brushes languidly wielded : witness the ashen gray of the mountain-summit edelweiss.

Quite characteristic of the even balance the scales of Nature hang is the patent fact that the display of colour her artists make proportionates to the love and admiration evinced for it. No hue is too vivid for the warm-blooded Mexican, no colouring too gaudy for the amorous Espaniol, or the romantic Neapolitan ; and is not Nature painted all around them in her brightest, most joyous mood, in pig-mental profusion ? Yet to the stern Laplander, the



IV.

stolid Scandinavian, has colouring been almost withheld. To study the gradual withholding of colour one has but to leave the valleys and climb to mountain summits.

“Go out in the springtime among the meadows that slope from the shores of the Swiss lakes to the roots of their lower mountains,” says Ruskin. “There, mingled with the taller gentians and the

SWISS WILD FLOWERS

white narcissus, the grass grows deep and free ; and as you follow the winding mountain-path, beneath arching boughs all veiled with blossom—paths that for ever droop and rise over the green banks and mounds, sweeping down in scented undulation steep to the blue water, studded here and there with new-mown heaps filling all the air with fainter sweetness—look up towards the higher hills, where the waves of everlasting green roll silently into their long inlets among the shadows of the pines, and we may perhaps at last know the meaning of those quiet words of the 147th Psalm, ‘He maketh grass to grow upon the mountains.’”

Here in the lowlands we are surrounded with

“Quaint enamelled eyes,
That on the green turf suck the honeyed showers,
And purple all the ground with vernal flowers.”

But as we ascend we see that, though their hues may remain as vivid and beauteous as ever—enhanced indeed by their surroundings—their wonted profusion falls off. Still further and the abundant variety, both in colouring and in *genus*, diminishes, and then in entering upon high altitudes the colouring becomes less vigorous, more delicate as growth becomes more fragile.

To our mind there is nothing more pleasurable, and yet at the same time pathetic, in climbing the glorious yet lonely Alps, than to come upon flowers

FLORAL COQUETRY

—lovely works of Nature, which are bred, to grow, blossom, become progenitors, wither, and die, perhaps never in the whole course of their lives to be seen by the eye of man ; yet they are there to

“Lull the senses, charm the eye,
Bloom and wither, breathe and die.”*

Is not the conviction at once brought home to us that they have been endued with beauty for other reasons than to please *our* eyes? Nature indeed has whispered to Science that they put on a beauteous garb, just as do maidens their most becoming dresses, to be admired, to please, and to attract those of their friends they wish for. The bees are their friends, and we know that they admire, not only distinctive flowers, but that they select the colours they love best. But do they search them out on these high-perched mountain Alps, or has evolution proceeded so far that the—to our minds—lonely flowers *do* select from their comrades those upon whom they choose to bestow their *amour*—the chosen ones to whom they send love missives by the fleet wings of the chill mountain *Æolus* in form of wedding pollen? When we encounter their pretty faces peeping out from rocky crags and apparent desolation, one needs ask, Whence come ye?

“Did some white-winged messenger,
On mercy’s mission, trust your timid germ

* Oscar Browning.

LONELY FLOWERS

To the cold cradle of eternal snows,
And, breathing on the callous icicles,
Bid them with tear-drops nurse ye?"*

Whoever the beneficent floriculturist may have been who first studded the Alpine slopes with flowerlets, whoever it may be that transplants, guards and tends them, there we find them far up, holding their own in chill clime, withstanding the harshest of buffetings, conquering in the battle of life; for though we ascend far above the zone of ordinary habitation, where both the wonders and the beauties arranged in the cabinets of Dame Nature would seem to be reserved for the unappreciative eye of the eagle and the chamois, save and except for the very occasional mountaineer and botanist, there still we find many a beautiful blossom hidden in rocky ledge and cranny; for it is but too true that

"Full many a flower is born to bloom unseen,
And waste its sweetness on the desert air."

To those conversant with that delightful science presuming to do something towards the classification and comprehension of these minute organisms of Nature of transcendent beauty—we will not say to the lover of flowers, for who is there among us with a sound mind who loves them not?—the true flowers of Nature are more entrancing than the

* L. H. Sigourney.

LONELY FLOWERS

pampered and cultivated ones. "To the true lover of Nature *wild* flowers have a charm which no garden can equal," says Lubbock. "Cultivated plants are but a living herbarium. They surpass, no doubt, the dried specimens of a museum, but, lovely as they are, they can be no more compared with the natural vegetation than the captives in the Zoological Gardens with the same wild species in their native forests and mountains."

It has been well shown by Dr. Herbert that many plants are found alone on a certain soil or subsoil in a wild state, not because such soil is favourable to them, but because they alone are capable of existing on it, and because all dangerous rivals are by its inhospitality removed. "Now if we withdraw the plant from this position," says Ruskin, "which it hardly endures, and supply it with the earth and maintain about it the temperature that it delights in, withdrawing from it at the same time all rivals which in such conditions Nature would have thrust upon it, we shall indeed obtain a magnificently developed example of the plant, colossal in size and splendid in organization; but we shall utterly lose in it that moral ideal which is dependent on its rigid fulfilment of its appointed functions. It was intended and created by the Deity for the covering of those lonely spots where no other plant could live. It has been thereto endowed with courage and strength and capacities of endurance, its character and glory

BOTANY

are not, therefore, in the gluttonous and idle feeding of its own over-luxuriance, at the expense of other creatures utterly destroyed and rooted out for its good alone, but in its right doing of its hard duty ; climbing into those spots of forlorn hope, where it alone can bear witness to the kindness and presence of the Spirit that cutteth out rivers among the rocks, as He covers the valleys with corn ; and there in its vanward place, and only there, where nothing is withdrawn for it, nor hurt by it, and where nothing can take part."

A glorious, elevating study, that of flowers ! How reverentially doth the poet speak of them :

" Learn this, my friend,
The secret that doth make a flower a flower,
So frames it, that to bloom is to be sweet,
And to receive to give. The flower can die,
But cannot change its nature ; though the earth
Starve it, and the reluctant air defraud,
No soil so sterile and no living lot
So poor, but it hath somewhat still to spare
In bounteous odours."

What would the world be without these painters of Dame Nature ! How often does one hear a cultured woman exclaim : " I could not *live* without flowers " ; yet " flowers seem intended for the solace of ordinary humanity : children love them ; quiet, contented, ordinary people love them as they grow ; luxurious and disorderly people rejoice in them

THE SCENE-PAINTERS

gathered; they are the cottager's treasure, and in the crowded town mark, as with a little broken fragment of rainbow, the windows of the workers in whose hearts rests the covenant of peace."*

Nevertheless, as we ascend we are forced to forego the friendship of flowers, for

"Slow toiling upward from the misty vale,
We leave the bright enamelled zones below."

As we approach the snow-line, first the grass and then the scanty herbage forsakes us. All colour is waning, and sparse indeed are flowering things. All Alpiners know full well that

"No more for them their beauteous bloom shall glow,
Their lingering sweetness load the morning gale."†

Flowers may be considered to be "Nature's painters," whose duty it is to paint in the beauteous details, to throw into the landscape its most surprising contrasts, its most vivid colouring. But who are the painters who fill in the background, who complete the "harmonious whole," who produce those entrancing blendings, those restful gradings, that satiating toning of more sober hue? Are they not the grass and the trees?

What do we not owe to the grass alone! Ye happy dwellers in the verdant country-side—ye who can gaze upon the emerald of spring, the green velvet of summer, the bronze plush of autumn—

* John Ruskin.

† Oliver W. Holmes.

GRASS

you can scarce be trusted to reply. But let your vocation enchain you within the demesne of the smoke fiend, the too-well-defined *ceinture* of Commerce, where all is colourless and sable, or within the workshop of Vulcan, the "Black Country"; spend you your days in the emboweling of the earth for the blackened verdure of past ages, the smelting of her iron-veined rocks, scorched by streams of molten metal instead of by the joyous beams of an absent sun, hidden behind the funereal pall of sulphurous smoke; then as you emerge upon Nature, virgin and unseared, may you appreciate the value of grass.

How greatly, too, is enhanced the entrancing beauty of Alpine passes by the presence of trees, to the mountaineer more constant friends than the grass! As we journey upwards there we see them painting Nature where all else is near colourless, embellishing precipitous ravines, stone-bestrewn chasms, and rocky headlands, which make us to admire, not alone them intrinsically, but their bold tenacity in finding sustenance in such inhospitable environment.

When we see trees thus intelligently striving for existence, gripping with tenacious fingers the lithic boulders, thrusting tiny tentacles into imperceptible clefts, bending their forms out to catch glimpses of glorious but rarely bestowed sunshine, clustering where they may drink at the trickling streamlet, or hiding from searching glacier winds, it requires

ARBORICULTURAL BATTLES

little imagination to regard them, too, as conscious things. And whatever is in them lovely in the lowland scenery becomes lovelier as we ascend to moderate altitudes.

“The trees, which grow heavily and stiffly from the level line of plain, assume strange curves of strength and grace as they bend themselves against the mountain-side. They breathe more freely and toss their branches more carelessly as each climbs higher, looking to the clear light above the topmost leaves of its brother tree; the flowers, which on the arable plain fall before the scythe, now find out for themselves unapproachable places, where year by year they gather into happier fellowship and fear no evil.”

Truly for a time they “fear no evil,” and bravely do they mount with us towards the mountain crest; but are they not punished for their temerity, for does not their vitality diminish unhappily with their “fellowship”? The mountain pines are staunch friends to us; long after we have bid adieu to the grass and passed through the chestnut groves they bear us company—long, indeed, after the beauteous companionship of the Alpine flowers has been denied us; for

“Few are the slender flowerets, scentless, pale,
That on their ice-clad stems all trembling blow
Along the margin of unmelting snow.”*

* Oliver W. Holmes.

ARBORICULTURAL BATTLES

Yet it is almost pathetic to view them, so sadly changed are their once symmetrical and correctly erect forms. Now indeed,

“Like leaning masts of stranded ships appear
The pines that near the crests their summits rear.”

Still upward as we enter amid “amazing rocks,” the mountain ash and solemn sounding pine forsake us and leave us to the sole companionship of the Alpine *Tannen*.

Breasting yet another giant headland, we find the trees making their last stand. They have nobly battled against great odds; now are they scarce able to survive the onslaughts of so many mountain foes. They no longer rear erect their steeple-pointed tips; they no longer point heavenward. Such as remain have curved spines, and feebly rest their bent arms on huge mountain boulders. Here vegetation is sparse indeed, even the weakly little dwarf pines; the *Tannen*—the boldest of their kind—now forsake us.

These slender little *Tannen*, these mountain “Christmas-trees,” are doubtless what Wordsworth refers to as *Aërial* pines, and truly do these

“Aerial pines from loftier steeps ascend,
Nor stop but where creation seems to end.”

Now, indeed, as we laboriously clamber from one rocky boulder to another, suddenly rising above both

ABOVE THE TREE ZONE

animate and vegetative companionship, "Creation seems to end," for

"No product here the barren hills afford,
No vernal blooms the torpid rocks array,
But winter lingering chills the lap of May."*

We turn to look down upon the profound valleys, and scanning the brusque and awful rocky headlands all around us, we appreciate that we have risen above the zone of trees and can no longer look to these of "Nature's painters" to temper the lithic harshness of her face, now pale, almost colourless. And strange indeed it is, in stumbling o'er the *débris*—that broad band of desolation, that harsh line of demarcation between struggling herbage and eternal snow—to see, here and there, in rocky nook and crevice, the enlivening colour of a mountain-summit flower. For we are now at that height where

"Tree nor shrub
Dare the drear atmosphere; no polar-pine
Uplifts a veteran front; yet there thou art,
Leaning your cheeks against the thick-ribbed ice,
And looking up with steadfast eye to Him
Who bids ye bloom unblanch'd amid the realm
Of desolation."†

Down in the valley are fields and gardens smiling upon us, the fruit-trees hanging their branches over the fences of cottage and chalet, demonstrating ease of existence with abundant crops.

* Oliver Goldsmith.

† L. H. Sigourney.

ABOVE THE TREE ZONE

"Breath and life so warm and sweet
Are round the ancient mountain's feet.
The crocus o'er the fields will roam,
Until the golden age has come,
Of glist'ning kingcups shining far
From the green earth, as many a star
From blue-black sky shall shine to-night,
And quench the flowers' softer light."*

Then we leave this region of fruit and corn and pass through a belt of pine and fir, the wind sighing gently in their evergreen branches, whispering to us stories of storm and sunshine, of winter cold and summer heat. Then we walk across open Alps, here and there coloured by a species of rhododendron—aptly called the Alpen-Rose—with their dark shining leaves and ruddy blossoms.

"Meadows with asphodel and lily flowers
O'er-silvered, as our English fields in May
Are gilt with buttercups, wind-ruffled hay
Exhaling summery spice in noontide hours.
Bare-crested crags, gaunt battlemented towers,
Purple with silk-enwoven peony spray ;
Each black-browed ledge, where late the snow-wreaths
lay,
Plumed with auriculas and dewed with showers."†

Leaving the larger trees behind, we come to the higher grass pastures, dotted here and there with beauteous flowers.

* Beatrice A. Tollemache.

† John Addington Symonds.

ABOVE THE TREE ZONE

“Gorgeous flowerets in the sunlight shining,
Blossoms flaunting in the eye of day,
Tremulous leaves with soft and silver lining,
Buds that open only to decay.”*

The violet bells of the Soldenella, the gold of the cinquefoil, the staring red of the silene and primula, are all in contrast with the glorious blue—in azure vying with the firmament above—of the gentians. Still the list is not exhausted—white crowfoot, golden auricula, blue forget-me-nots, all are there; while the delicate little yellow Alpen violet hides itself away, saxifrages of every colour flaunt themselves from every crag.

“And the rocks are blushing red
With the tiny campion’s head;
Not a footstep but doth press
On some sweet new loveliness.”

Twere a glorious study to investigate how floral idiosyncrasies are modified by Alpine residence, but we must not be tempted into entering upon it here. Nevertheless, it is palpable that, as we ascend and plants become rarer, they also change their form, and become possessed of special armament to do battle with their braver elemental enemies. We see a ragwort—it is gray-leaved; a milfoil—it has white leaves; a cinquefoil—it is furnished with silky foliage. We pluck a whitlow grass only to find its leaves and stems thickly covered with a soft felt. All these

* Longfellow.

ABOVE THE TREE ZONE

are special provisions of Dame Nature, defensive measures, additional armour. This felt, for example, prevents the sun from too greedily evaporating away the precious water so necessary to the sustenance of the frail organisms—water so difficult to obtain high up on these Alpine slopes.

Close beside us, in colourless modesty, are other examples, the gray, silk-coated *Edebraut*, the white, flannel-like *Edelweiss*, flowers dwelling in snow, owning a habitat where no other flowering plant may survive.

Very appositely have the following words been placed in the lips of this solitary and far-sought flower :

“I was born in my little shroud,
All woolly, warm and white ;
I live in the mist and the cloud,
I live for my own delight.

I see far beneath me crowd
The Alpine roses red,
And the gentian blue, sun-fed,
That makes the valleys bright.

“I bloom for the eagle’s eye,
I bloom for the daring hand.”*

Yet here we have not finished, for floral temerity carries their dauntless, though fragile, forms e’en into the camp of the enemy, some forsooth providing themselves with means and apparatus for

* Dora Greenwell.

ABOVE THE TREE ZONE

melting that same snow which has slain their compatriots.

In April the edge of the *névé* is covered with a wealth of beauteous bell-shaped, purple blossoms, the flowers of the *Soldanella*. There on the ice-covered edge of the snow-line you see an abundance of tiny stalks, each surmounted by twin, nodding, bell-shaped flowers. It is worth while pausing a moment to see how a plant can blossom in such a harsh and uninviting habitat. Every plant is engaged by means of its leaves in manufacturing and storing food for future use. This food, in the form of starch, sugar, or oil, is stored in the stems, or if an evergreen—as is *Soldanella*—in both leaves and stems, so that the plant may have a store on which to draw when it wants to throw out its buds and blossoms in the spring-time. Plants, like animals, when they consume this food-store, require oxygen. With the aid of the oxygen they burn up or consume the food, and give out as a result and product of the work done a considerable amount of heat, so that a growing bud or a germinating seed is at a considerably higher temperature than the surrounding air.

The *Soldanella* spends all the summer months in storing up its leaves with these food products, so that in the autumn they are thick and fleshy; they are also covered with a thick protective skin and lie flat on the earth, so that the snow gathering over them

ABOVE THE TREE ZONE

cannot hurt them in any way. Covered with the icy sheet of the *névé*, they lie dormant until the first glimpse of the spring sun melts a portion of the snow and sends a trickle of water through its substance to their roots. This water wakens them to activity; they gather in the oxygen from the imprisoned air always to be found in some quantity in the snow-sheet, and commence the consumption of the food-store in their leaves.

The heat given out by the growing plant-bud melts the surrounding ice, and gives more water to the root to help forward the growth of that same bud. So it pushes its way upward, melting a tubular path for itself by its own heat as it grows. In fact, as the stalk grows longer the water freezes again below the bud around the stalk, and we have the phenomenon of a bud growing in a globe with a long cylindrical neck which it has itself melted in a sheet of ice.

Thus it goes on pushing its way up through the snow-sheet, giving out heat at the expense of the fuel food which it draws from its leaves, until at last it bursts above the level of the *névé*, and the two flower buds are thrown out, expand, and blossom. But the leaves are not now thick and fleshy; we have but to cut down through the ice to find them, now thin and shrivelled, for they have burnt up much of their substance in melting a cave and burrowing upward through the snow.

THE SOLDANELLA

“Then here these little flowers,
Like lights of earliest morn,
Or rays of hope in sorrow seen
Shine on the slopes forlorn.
They break the snow with gentle force
And struggle toward the sun,
The chilly wreaths around them melt,
The streams beneath them run.”

Why should the *Soldanella* act like this? If we watch a bed of them in bloom for a time, we shall see that in and out of their nodding bells are flitting the newly-awakened bees, each of their bells so made that it neatly fits the body of the bee; and while the insects gather honey from the only flower as yet in blossom, they also take the golden pollen from bell to bell, and by cross-fertilizing insure the production of good, sound, healthy seeds for the production of future generations of *Soldanellæ*.

But why should not this plant wait for warmer weather, and grow when all the ice and snow has melted away, as do the grasses, the gentians, and other plants, which will appear later to beautify this spot? There is an answer to that. *Soldanella* is a low-growing plant; it does not rear its head aloft as do some of its compatriots, and thus if it elected to wait it would have little chance of attracting the bees, of appealing to their admiration amid the luxuriance of blossom of these later flowers, so it needs, perforce, seize time by the forelock, fight its way

THE SOLDANELLA

up to blossom early, show its face manfully in the world, or succumb in life's stern battle.

So it is interesting to note that when the snow has at length vanished the Soldanella has accomplished that which its neighbours are now only setting about to do ; thus it can give itself over to the gathering in of new food-stores, to the filling and fattening out of its new leaves, to the storage of fuel to take the place of that which has been expended in melting out its snow dwelling, in battling with its icy covering.

“There still secluded from the wealth
Of happier fields they blow,
Blooming and fading hour by hour
Near the retreating snow.
They bloom and fade, and do not shrink
From their appointed duty.”*

“The first time I saw the Soldanella Alpina it was growing of magnificent size on a sunny Alpine pasture, among bleating of sheep and lowing of cattle, associated with a profusion of *Geum Montanum* and *Ranunculus Pyrenæus*. I noticed it only because new to me, nor perceived any peculiar beauty in its cloven flower. Some days after I found it alone, among the rack of the higher clouds and howling of glacier winds ; and as I descried it, piercing through an edge of avalanche, which in its

* John Addington Symonds.

HACKING AT NATURE

retiring had left the new ground brown and lifeless, and as if burnt by recent fire, the plant was poor and feeble, and seemingly exhausted with its efforts; but it was then that I comprehended its ideal character, and saw its noble function and order of glory among the constellations of the earth.”*

Pleased though we are to see them here, flowers look out of place in such environment, in sparse clusters mid rocky desolation. Even in the lowlands, to our mind flowers never look at their best in isolation, for then they are less natural. Nor do they ever look so well in geometrical surroundings, no matter what may be the ability of the gardener. Flowers never look so delightful, so bright, yet so restful, as when nestling amid the verdant blades and spears of downland grass, far less do they look themselves in squares, in circles, stars and triangles, or other geometrical restraint and precise regularity in garden beds.

And so with the trees! To our mind it is sacrilege, showing at once want of taste and entire lack of ability to appreciate the beauteous forms of Nature, to carve into hideous contour—pheasants, peacocks, pigs—lovely rest-affording evergreens, as one but too frequently sees by roadside and in otherwise artistic—in Nature’s taste artistic—old-time gardens. No! let the trees grow as they list, let the flowers peep out from shrub and grass, such as we delight to

* John Ruskin.

FANTASTIC LITHIC STAINS

tread in mossy softness on our Southern downs or on our Irish mountains.

Such grass, such natural flower-beds, we find upon these little oases of the Alps, but higher on the mountains Nature's velvet-like cloak no longer gives us foothold—it withers into rankness and sparseness.

First we lose the grass, then the trees, and now we are in boulderland—borderland to the colourless for as we gaze still upwards all is virgin whiteness. Yet still around us colour has not wholly fled. Even at this altitude we are not quite reduced to that monotonous colouring, the cold gray of rock, which would obtain were it not for the accidental dyeing of their barren, inhospitable sides. Here they are enlivened by a blood-red splash from a ferruginous artery, there a streak of emerald green from a cupreous nodule, there, again, a mauve stripe with softly graded edges from a tannin-rooted tuft, the whole toned to a sombre hue of umber from the strong dyed peat. Thus does Nature's lightly handled crayon and camel-hair paint in subdued tints her rocky nakedness.

The “discolouration” of mountain-summit rocks is really very beautiful: the stains are as fantastic as they are varied; yet we feel there is a colouration suffusing the whole, more effective than the staining, and yet not caused by it. On one hand a vast upheaving rocky bastion has its gloomy chill-

LICHEN

ness effectively relieved by a brownish ruddy hue ; another, an acute pinnacle of vast size, seems to be reflecting the golden rays of a setting sun, so bright is its yellow colouring. But there is no sun, and all is gray gloom. To which of Nature's painters, then, are we now indebted for this enlivening—nay, ravishing—effect? Let us climb again to answer the inquiry.

Now we have entered the golden zone, only to find it due to the meekest, most primitive of her painters—the lichen.

We were much impressed with the companionship of the lichen, its charming, relieving influence, its tenacity, its hardihood. Well might we travesty well-known lines and say :

“Clinging where no life is seen,
A venturous plant is the lichen green.”

Here, in exhibiting its hardihood in its endeavour to weather Alpine snows and to brighten the barrenness of an arid waste—in both of which it is eminently successful—it seems to reflect a colour brighter and yet more vivid than it is wont to do in the lowlands, where it enamels with its welcome green the hardest stone, the smoothest tile, the barest slate, peeping out everywhere from the tiniest and most insignificant of crevices.

Here it grows alone and unheeded save by the botanist and student of Nature. Whilst he sees wonders in its every tissue, we scarcely pause to

LICHEN

reflect that the structure of these—primitive though we dub them — organisms, of which merely the colour delights us, is so recondite, so complicated, so wonderful, as entirely to baffle our comprehension.

“ Flower in the crannied wall,
I pluck you out of the crannies,
I hold you here, root and all, in my hand,
Little flower—but *if* I could understand
What *you* are, root and all, and all in all,
I should know what God and man is.”*

Truly marvellous lives have these lichens, for each of their often gaudily - coloured patches is composed of two distinct plants, an alga and a lichen. Division of labour has here reached perfection. The lichen encloses and protects the alga, and supplies it with water and dissolved salts, while the alga, by means of its coloured chlorophyll corpuscles, manufactures the organic food so necessary to both, and distributes it equally as their needs require. So each does its share, the one dependent upon the other.

Thus it is that by the automatic adjustment of the compensating - balance of Nature's wondrous mechanism her painters are enabled to dwell under such diverse conditions. But in the case of Alpine flowers some of the conditions, though abnormal, are conducive to their vigorous growth. The first thing that occurs to us is the abundance of fresh air, but

* Sydney Dobell.

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there is another glorious thing there also in abundance—light. Mountain days are long, their nights short, and of this the “meek dwellers” reap advantage. Not so many years ago it was considered that plants, like ourselves, required rest and sleep, but the advent of the electric light exploded the theory. Some seven-and-twenty years ago we planted two beds of flowers, allowing those in one to grow under natural conditions, whilst constraining the others to grow continuously by suspending above them a powerful electric light. Those that grew naturally were, of course, normal in appearance, all the plants being much higher than the artificially-propagated ones; for it is during the period of rest and sleep that the bodies of plants, like our own, grow longer. But the electric-light-grown plants, though stunted, were more sturdy, the green of their leaves was richer, the colouring of their blooms more vivid. The immediate result of debarring plants from light is a shedding of their leaves. During the prolonged fog of 1891 leaves fell in the palm-houses at Kew, and were swept up in bushels.

The other abnormal condition which at once occurs to us is the purity of the Alpine air. But the beneficial effect of this upon plant life would appear to be more paradoxical than that of light. True! plants may be considered to breathe, but the life-giving air to them is the converse of that required by our lungs. Each single green leaf of a growing

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plant is a chemical laboratory, wherein is decomposed the carbonic acid—otherwise carbon dioxide gas—of the air, the plant taking out the carbon, on which it feeds, giving back the oxygen to the atmosphere.

Not every embryo chemist could perform this analysis; yet the plant, without knowing the why and wherefore, does it, and for this purpose is furnished with lungs, or *stomata*. In each case the problem is to provide the greatest surface in the least space. Our lungs expose a great expanse of surface in a comparatively very small space. Plants' lungs are among the infinitely little and infinitely wonderful things that the microscope has revealed. They amount to many thousands on the square inch, and on a single leaf of lilac as many as 708,750 have been counted, whilst in regard to our lungs it has been estimated that each of the exceedingly numerous terminal bronchial tubes have attached some eighteen thousand air-cells, of which the total number amounts to about *six hundred millions*.

The plant can only take up the carbon from the air when the leaf is illuminated. The chlorophyll—literally, leaf-green—which is essential to the nutrition of every part, the plant can only manufacture under the stimulus of light.

But where does the pure mountain air get its carbonic acid—its CO_2 —from? Down in the lowlands it is exhaled in the sweet breath of the cattle directly upon the herbage. The air of towns,

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befouled by the breath of their teeming denizens, is wafted to the adjacent trees and pastures. Every gas-burner, every fire-grate, every factory, is exhaling it in abundance, but how does it get up here? Yet it is here, but in infinitesimal quantity.*

Nevertheless, flowers and plants require *pure* air in the sense of its freedom from dust and smoke, for their lungs are easily choked by smoke and fog.† Moreover, plants in their breathing, like ourselves, exhale a large quantity of moisture. Of all the operations of vegetable life, this transpiration of moisture is the most active; it has been calculated that some of the common agricultural cereals and roots exhale during five months of growth more than two hundred times their dry weight of water. A single sunflower will evaporate as much as twenty to thirty ounces of liquid in twelve hours. Now, smoke-fog checks this evaporation, and by so doing the vitality of the plant is lowered. At Kew a device is resorted to for minimizing the mephitic effect of fog. When the cloud pall is settling over the nurseries, the order is given to lower the temperature within the conservatories as far as may be

* See reference to this in Chapter V.

† According to Sir W. Thiselton-Dyer, the Director of Kew Gardens, experiments at Chelsea during a London fog showed that in a week six tons of solid matter were deposited on a square mile. They included not only soot, but a variety of tarry hydrocarbons, highly injurious to animal and vegetable life.

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done without endangering the plants. The effect of this is to check vitality, to induce a sort of semi-torpidity. Heat is the stimulus of vegetative life, but it is baneful to the plant if light be withdrawn and the air charged with noxious elements. So the plant lives more slowly till daylight is restored and there is fresh air and free evaporation.

Happy Alpine dwellers, that ye need not the pamperings necessitated by the artificiality man has wrought! We think usually of a leaf or flower, a stem or branch, as consisting mainly of carbon got from the air, of nitrogen drawn up from the soil, and elaborated by a wondrous vegetable chemistry from the ammonia present within reach of the hairlike capillaries of the roots, plus a little oxygen from the air, and a considerable allowance of water. But the organisms are by no means so simple. They require for their building up a considerable range of mineral ingredients, such as potash, lime, phosphorus, magnesia and silica, or flint. Iron is believed to be a universal and indispensable element for the production of chlorophyll. These and every other single constituent of the daily fare, excepting those which the leaves absorb directly from the atmosphere, must be conveyed in the sap, and the strength of the current which does the work will depend upon the evaporation from the leaves. By what sort of capillary attraction the fluids are carried up from the roots of a tall tree to its topmost leaves is a

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mystery, but that it depends somehow on the evaporation can be demonstrated. Evaporation, however, depends principally upon light, and here on the Alps is abundance of it.

We have likened the stomata of plants to the lungs of man, and have shown that their functions are inversely analogous, but the strange fact remains—so interestingly shown by the electric light experiments to which we have referred—that the breathing of the plant is dependent upon light, whereas we know that our own breathing proceeds equally well by night as by day.

It is interesting to reflect why this should be, and to understand it we have to consider of what our atmosphere is composed. Its components are oxygen 23 parts, and nitrogen 77. But the point to be noted is that these ingredients do not *combine* to form air, as oxygen and hydrogen coalesce to form water; they merely commingle and become mixed, plum-pudding fashion. Now, when we breathe, our lungs *select* from the mixture the ingredient they require—namely, the oxygen. But strangely enough, in their darkened recesses they effect a true chemical combination of this ingredient, oxygen, with the *débris* of our blood in forming another gas—carbon dioxide. In doing this they act the part of *cuisine* for the vegetable world, for this lung-expired gas is the plant's food. But its food is thus a true compound, which Nature has ordained its leaves shall

PLANTS

be incapable of splitting up into its component parts, except with the assistance of light.

In this we see the wondrous interlacing, the dexterous balancings, of Dame Nature. There walks and grazes the animal!—polluting the atmosphere, defiling the earth. There stands the tree!—busily rectifying the aberration of the former, the meadows obliterating the latter. Every animal is feeding a tree, every tree is imparting health to an animal.

What a glorious cycle it is, if we but pause a moment to reflect upon it! Indeed, the simple chemical processes we have referred to as taking place during the breathing of animal and vegetable may be taken as an easy, yet typical, exemplification of the working of one of Dame Nature's inexorable laws—a law the discovery of which marked last century as an epoch of the greatest moment in the acquisition of scientific knowledge, the extraction of secrets from Dame Nature's strong-room; for it may be used as an example of that law known as the "conservation of energy," more popularly expressed as the "indestructibility of matter."

Let us take this book and throw it upon the fire!—as we fear some of our readers may be tempted to do. Before doing so, however, let us reflect that it is composed wholly of vegetable products. Its covers—or boards—are of pulped-down trees, its pages of boiled-down grass and disintegrated cotton-plant. As it burns these substances will combine with the

PLANTS

oxygen contained in the air of the room, the resultant gas will pass up the chimney, and, escaping into the free atmosphere, will diffuse among woods and fields. Millions upon millions of inanimate mouths will swallow it, and it (our book) will become of their body corporate. But the book was originally built up out of the bodies of trees and leaves and grass, and so shall it be resurrected again into another book.

But, you may say, not the whole of the book passed up the chimney, for there are the white ashes still in the grate. These white ashes, however, will be thrown upon the land, the kindly rains will fall upon them, and will wash them down to the roots of tree and flower. And they—these wondrous inanimate organisms—will resurrect them, will drag them up from Mother Earth, will assimilate them into their bodies, will present them again to the delighted eye of the traveller an integral of their lovely, beautifully-coloured landscape-painting blossoms; and thus may Nature's painters claim and confiscate these very pages which have dared to talk of them.

We have referred to the effect of dust upon vegetation, but the reader may exclaim, Surely there can be no such thing as *dust* upon the mountain summits!

Looked at from afar, the snow-caps are so dazzling white that snow and dust would indeed seem most

MOUNTAIN DUST

incongruous. Yet well the mountaineer knows that in tramping over the vast snow-fields—so white that he must oft don darkened glasses to subdue their glare—if he carefully examine the blanched surface, he will find it simply smothered with tiny spots looking jet black upon the white. He knows, moreover, that if he carefully take one up upon the corner of a leaf of his note-book, each sullyng spot is a nodule of mud. At first it seems strange that the snow should be thus flecked, and he involuntarily looks round for some distant smoke pall to account for it—as it would upon the snow of a lofty Yorkshire moor—but he sees naught save a sky and atmosphere of crystal purity. He then reflects that if this crystal carpeting could by some means be evenly o'erspread with a layer of dust, as upon an ordinary carpet, this impalpable powder, upon a slight thawing of the glissant surface, would at once cohere and collect itself up into these specks or nodules, as he sees them all around him.

Yet it seems strange that there should be such a thing as dust here, far up above the world, as it were, for we are apt to forget that it is carried hither, not only upwards from below by currents of air and by evaporation, but that it also descends upon our earth from the realms of space.

Wonderful indeed it is to reflect that we are being eternally subjected to a veritable bombardment of celestial-born projectiles, of far-travelled meteors.

METEORS

Yet it has been computed that our earth every day encounters over seven millions of such meteors, which, whilst adding a hundred tons to its weight, at the same time demonstrate how intrinsically small they each must be. Happily for us, these dissipate in the upper regions of our atmosphere, so that, instead of frequent showers of stones descending with deadly force, we have a tranquil falling through our atmosphere of impalpable dust.*

It is indeed a merciful providence that dust does exist upon the mountain summits and far above, for were there no *dust* there would be no *sky*, since the beauteous sky we see above us is nothing more nor less than the reflection of the sun's light from the surfaces of these myriad dust particles. The dust motes, indeed—individually invisible—are as so many million mirrors catching the glorious light waves as they go speeding through space, and beneficently bending them from their course to light up, not alone the sky above us, causing “the firmament of heaven to give light upon the earth” and lifting the darkness from “upon the face of the deep,” but illumining in the ravishment of its subtle divers

* The speed with which meteoric dust settles down upon our earth is incredibly slow. It must take very many years, for it has been found that years are required even for the dust within a quiescent glass flask to settle upon its sides, whilst, although dust in water subsides far more rapidly, Sir Humphrey Davy found a bottle containing a solution of gold took more than a year to settle.

DUST A PAINTER

hues the colouring of Nature's picture spread around us.*

Nay, more! The glorious colourings of the sky are due to the particular angle at which his rays—though he himself be invisible to us—strike and rebound from the atmospheric dust. The *éclat*, the beauteous hues, the inexpressible colour blendings, of the tranquil British twilight, of which we are so proud, are due to the reflected light of the sun when he has sunk some eighteen degrees below the verdant horizon—the reflex refulgence from dust banners hung on high some eight-and-thirty miles o'erhead.†

* It was observed in 1883, after the great eruption of the volcano Krakatoa in the Southern Seas, that the duration of twilight was increased, due to the dust emitted by the eruption, which remained for more than a year suspended at a height of at least sixty miles. The recent eruptions in the West Indies have, moreover, had their effect upon the British sunset.

† The calculations of the various savants as to the depth or height of our world's atmosphere vary considerably. Biot estimated that the depth was only about 40 miles, Bravais 70, and Mann 81. But Callandrau put it at 100 miles, Schiaparelli at 125, and Marie Davy at 187 miles, whilst Ritter states that it reaches a height of 216 miles. In Great Britain during the early part of the last century, the depth of the atmosphere was generally accepted as being 47 miles, but the fact that meteors become incandescent at a much greater altitude incontrovertibly proves that this calculation was fallacious. Sir Robert Ball states that meteors have been observed at an altitude of more than 200 miles, and since they only become incandescent when they come into contact with our air, the calculation of Ritter appears to be

DUST PAINTS THE SKY

From this we learn that an invisible thing—
atmospheric dust—whose presence we should not
even have suspected, may also claim to be one of
“Dame Nature’s painters”—one, indeed, of pre-
eminent importance. What would our world be
without the glorious sky? Nay, what would it be
without the soul-awakening dawn with its vivid
accelerando colourings, the soothing, rest-inviting
twilight with its subdued *andante* waning?—yet
neither could have its being without dust.

It teaches us, moreover—but we are apt to over-
look it—that whatever may appear to our eyes as
alone useless and detrimental is sure to have another
side to its nature, so as to be at the same time
useful and beneficial. Dust we consider our enemy,
but here it is our friend. The microbe, a thing
sometimes to be strenuously avoided, yet is also to
be sought after. The one of his species inflicts the
wound; the other heals it.

But the reader will say, “Surely microbes, germs,
bacilli, and the like, have no existence upon the
mountains? And even were they there, assuredly
they could have nothing to say regarding the paint-
ing of Nature’s pictures!” Yet nevertheless they
are there, far, far up the greatest height at which

the more correct. It is improbable that any appreciable line of
demarcation exists, or that our atmosphere ceases as constituted
below, it being more probable that the gases composing the
atmosphere extend to heights each proportional to its density.

MICROBES ON THE MOUNTAINS

they have been sought.* We may rest assured they are there for a good purpose. Indeed—strange though it may seem—to a lonely-dwelling, ice-loving germ we are indebted for a most extraordinary—nay, startling—painting of an erstwhile blank and colourless scene.

Blood-red snow—extraordinary incongruity!—can such be painted by any of Dame Nature's artists, and which? Yet, in exploring these bare and frigid regions in summer-time, one sometimes haps upon bright blood-red snow-fields. Such have stricken terror into some, and have paralyzed with awe the superstitious mountaineers, who deem them warnings of ill omen.

* A small quantity of clear broth was introduced into a number of little flasks, the necks of which were then drawn out to a fine aperture. The contents were then heated to boiling for some time, and by so doing not only was the air driven out of the flask, but the contents were rendered sterile; after this the aperture was closed by heating it in a flame. Armed with his little battery of such flasks, Pasteur started for Arbois. Here, in the open country, away from all houses, he opened twenty; on the lower heights of the Jura Mountains twenty more were opened; and, again, the same number at the Montanvert, close to the *Mer de Glace*, at a height of upwards of 6,000 feet. On re-sealing all the flasks he straightway returned to Paris, and deposited them in the bureau of the Academy of Sciences in November, 1860. The results, which were awaited with the utmost interest, were as follows: Of the twenty flasks opened near Arbois, eight developed living organisms; of the twenty opened on the Jura, five became affected; of the twenty flasks, however, opened on the Montanvert, only one exhibited germ life.

BLOOD-RED SNOW

But let the unsuperstitious explorer take up some of this red snow and carefully examine it by means of his microscope, and what does he find? Strange to relate, that its colour is due to minute living—nay, moving—organisms. Here, indeed, in the depressions caused by the melting of the snow by the summer sun, we find flourishing and thriving—often at a temperature far below the freezing-point—these minute vegetal animalculæ, oval in shape, blood-red in colour. They consist each of a single cell, just a thin wall with its contained protoplasm, so different from the myriad congregated cells components of even the commonest of our garden flowers. Though *quasi* plants, they have no root, no means of anchorage; it were impossible up here on their snow-spread beds. They possess instead means of locomotion, for at the narrower end of their spherical bodies are two *annulæ*, or wheels, of tiny hairs, called *ciliæ*; these they can rapidly rotate, and so dart backwards and forwards, forming ever-moving, ever-shifting colonies. They wander, doubtless, in search of food, for they feed upon the *organic* constituents of the dust blown up on to the snow, especially the pollen grains wafted thence in vast numbers from the pine-trees lower down the mountain-side, and which have failed to reach the destination Nature had intended. Yet are they not wasted, since they enter the larder of these minute snow-dwellers. But their food cometh not during the winter. What

THE REALMS OF ETERNAL SNOW

then do these quaint painters, these interesting *Spherærellæ nivalis*, and how spend their time? Just, indeed, as does the dormouse in his nest, or the bear upon his snowy plain, they hibernate, they sleep, until the summer sun shall again melt off the covering shed upon them during the winter, until it warm them back to active life, again—to paint a cheerless scene.

Again upwards, but a few score yards, and we are upon the summits; we feel ourselves indeed in the realms of eternal snow. Yet e'en here it is not "void and without colour," though

"The glorious mountain stands white as a bride
Alone, above. The lesser mountain lights
Stand for a hundred miles from east to west
Unkindled yet. Unnumbered shimmering ways
Melting from moonlight into ashen gray,
Mark the mysterious kingdom of the snow;
The upper world with all its territories
Stretches itself in revelation clear."*

E'en here, where, at first sight, all around seems white, yet may we find entrancing colouring, for merging into the general whiteness of the even snow are the beautiful greens, the lovely azures, of the crevasses formed in snow and ice. Here indeed the eye becomes both more sensitive and more appreciative: it detects the feeble yet glorious gradations with both pleasure and gratitude, gradations

* H. King.

SNOW FLAMES

rendered the more entrancing by the all-pervading whiteness. So sensitive indeed does the eye become that light is seen to be emitted at each crushing and cracking of the summit snow; every step our companions take is accompanied by a flash. We have but to thrust our alpenstock deep into the compact snows to bring forth a veritable flame. This mysterious lambent light so suddenly provoked of a rich and ravishing azure we have seen most resplendent upon Monte Rosa and upon the Oetler. Tyndall several times refers to this phenomenon. When crossing the Stelvio, he says: "Near the snow-line the partial melting of the snow had rendered it coarsely granular, but as we ascended it became finer, and the light emitted from its cracks and cavities a pure and deep blue. When a staff was driven into the snow low down the mountain, the colour of the light in the orifice was scarcely sensibly blue, but higher up this increased in a wonderful degree, and at the summit the effect was marvellous. I struck my staff into the snow, and turned it round and round; the surrounding snow cracked repeatedly, and flashes of blue light issued from the fissures. The fragments of snow that adhered to the staff were, by contrast, of a beautiful pink yellow, so that, on moving the staff with such fragments attached to it up and down, it was difficult to resist the impression that a pink flame was ascending and descending in the hole.

SNOW FLAMES

As we went down the other side of the pass, the effect became more and more feeble, until, near the snow-line, it almost wholly disappeared. It might perhaps be thought that the blue of the sky might have a causal effect in these wonderful manifestations; but this is not the case, for we have observed the effect in equal beauty when the sky has been obscured by mist, and, indeed, in a heavy snowstorm."

The condition of the snow, however, markedly effects the phenomenon, it being most pronounced in fresh-fallen snow. This is borne out by the following remark of Tyndall's: "As I ascended Monte Rosa I often examined the holes made in the snow by our batons, but the light which issued from them was scarcely perceptibly blue. Now, however, a deep layer of fresh snow overspread the mountain, and the effect was magnificent. Along the Camm I was continually surprised and delighted at the blue gleams which issued from the broken or perforated stratum of new snow; each hole made by the staff was filled with a light as pure, and nearly as deep, as that of the unclouded firmament. When we reached the bottom of the Camm, Lauener came to the front, and tramped before me. As his feet rose out of the snow and shook the latter off in fragments, sudden and wonderful gleams of blue light flashed from them. A very curious effect we have noted is that if the alpenstock be left in the hole, although there may be a sufficient space all

THE ALPEN GLOW

round it, the beautiful refulgence refuses to assert itself."

The pink flame thus seen by Tyndall probably did not exist beyond the limit of his own eye, for here in the realm of snow most magnificent and surprising demonstrations of colour are frequently witnessed which have no being. These tints are due to what are called *subjective colours*—an entrancing study—viz., colours which are produced upon our *retina* by contrast. We are sorry to disillusion the reader, but would remark that probably many of the gorgeous colours and contrasts of that most wonderful sight to be witnessed upon the mountains, the *Alpen glow*, exist only in our imagination. If we threw a bright red handkerchief upon the snow and looked at it intently for a few seconds—as we should look at the *Alpen glow*—we should find in a little time that it becomes surrounded by a halo of green ; now, if the handkerchief be removed, the entire space it occupied upon the snow will appear green, yet we know the green colour does not exist.

Let us spread out the handkerchief upon the snow again, look at it steadfastly, and then raise the eyes to a bright white cloud, and there upon its soft white expanse we shall see our red handkerchief, much magnified, but no longer red, for there it is of a deep-green colour. Or we may attach a red wafer to a piece of red glass, then, if we look at the sky through the glass, the wafer will appear green.

THE ALPEN GLOW

Such effects can also be obtained in our own homes—but they are far less entrancing—as, for example, by throwing the light of a magic lantern through a red glass on to a white screen; then, if we place some solid body in the ray, its shadow will be green, not black, whilst a blue glass would not give a dark shadow at all, but a bright yellow one.

But we must not dwell upon these interesting and beautiful chromatic effects, but rather press farther up the mountain, and here we find the summit snow of excessively fine grain, whilst these beautiful effects are produced with such facility that one has not to pierce or dig deeply—indeed, every thrust of one's ice-axe delights us with the blue gleams which are produced, each hole it makes being suffused with a light as pure and nearly as deep as that of the unclouded firmament. Nay, more! As our companions in front of us raise their feet out of the snow and the fragments fall from their Alpine, nail-covered boots, sudden and wonderful gleams of light flash forth.

It is, perhaps, but natural to ascribe the blue snow colourings to the blueness of the sky, and this may have some effect in its production; but the true cause is the wondrous crystalline formation of the snow itself, which, as we crush it under foot, we think to be mere powder. Yet how egregiously are we mistaken. Catch a few flakes upon a piece of black velvet, or even examine those that have fallen

GLACIAL FLOWERS

upon your hat, and what do we see—some powder? Far from it; we see beauteous glacial flowers—not an ill-arranged fleck, each of perfect and studied form. They may vary with the storm and place, but they are always beauteously geometrical, usually six-leaved, some of these leaves throwing out lateral ribs like ferns. Some are rectilinear, others are curvilinear, others, again, arrowy and serrated; some close and compact, others open, reticulate, and lace-like.

Do we pause to reflect when caught in a snow-storm, and the gay and flocculent flakes are dancing and whirling around us, that they are tossing at us veritable bouquets of flowers in their myriads?

“Snow! Pure virgin, spotless snow!
How very few among us know
That each and every thy fleecy flakes
A complete and beauteous crystal makes;
Crushed as naught 'neath foot of man,
Yet never a one among them can
Reconstruct thee on a plan
Half so lovely, half so grand
As thee. Cold, icy-fingered hand
Of snow! Pure, virgin, spotless snow.”*

Do we pause to think or to try to picture the incomprehensible influences at work from the time when the condensation of transparent vapour into clouds gives them their birth, or of the power—

* A. R. Sennett.

GLACIAL FLOWERS

we were almost writing intelligence—which agglomerates the chill and tiny particles into such beauteous flowers? It is as wonderful to think of as it is beauteous to behold.

“Let us imagine,” says Tyndall, “the eye gifted with a microscopic power sufficient to enable us to see the molecules which composed these starry crystals; to observe the solid nucleus formed and floating in the air, to see it drawing towards it its allied atoms, and these arranging themselves as if they moved to music, and ended by rendering the music concrete.”

Surely such an exhibition of power, such an apparent demonstration of a resident intelligence in what we are accustomed



v.

to call “inert matter,” would appear perfectly miraculous. And yet the reality would, if we could see it, transcend the fancy. If the Houses of Parliament were built up by the forces resident in their own bricks and lithologic blocks, and without the aid of hodman or mason, there would be nothing intrinsically more wonderful in the process than in the molecular architecture which delighted us upon the summit of Mont Rosa.

Snow and hail are generally associated terms, and one often meets with the latter in ascending these

SNOW AND HAIL

mountains. While snow is formed by the ascension of a cloud into an atmosphere so cold that its vapour becomes gradually solidified, hail is formed by the sudden freezing of the rain as it falls towards the earth. Even the hailstones have their shapes. Should they fall from no very great height we notice that they are perfect spheres of ice, but should they come pelting down from greater heights they tend to become frozen cones with rounded bases, or, perhaps, hollow spheres with truncated apex and convex base, and this, perhaps, is due to their rapid descent through the air: for the air in front of a dropping hailstone must necessarily be compressed and warmed in comparison with the air behind, which is rarefied and cooled.

Yet, again, here, far up above the habited world,

“High up in heaven above the unfading snow,
Laved by strong ocean floods of confluent light,”

have we not a glorious compensation for the fading out of all colour from our frigid carpeting? Turn we our eyes heavenward and we learn that we are beneath an entrancing canopy, a ceiling of transcendental splendour, such as can only be viewed from the crests of these gloriously majestic mountains.

Perhaps here upon the Alps our interest is whetted, our appreciation enhanced by the wild contrast. Behind us, regiment behind regiment, the

THE REALM OF SPACE

rugged mountains die away, o'erhung by clouds of apposite stern and rugged waywardness, varied as the summits. Before us as a vast ocean—far as eye can scan—of soft and placid, unvaried and unbroken azure of deepest hue, stretches away the soft, the amorous sky of fair Italia.

“Soft skies of Italy ! how richly drest,
Smile these wild scenes in your purpureal glow !
What glorious hues, reflected from the west,
Float o'er the dwellings of eternal snow !”*

It is indeed “o'er these dwellings of eternal snow,” normally presenting a picture painted in Nature's weakest colouring, that she twice diurnally throws the most vivid, the most soul-inspiring, example of her chromatic might destined for the eye of man—veritably her *chefs d'œuvres*. For the glory of the mountains are those transcendently executed pictures, sunrise and sunset. The grandeur of these is known in their supreme *éclat* to the mountaineer alone.

One of the pleasures of travel in Switzerland is the calm contemplation of her lovely sunsets ; one of the excitements, the observation of her *Alpenglow* ; yet these pall before the magnificence of the mountain sunrise and afterglow. Moreover, the pleasure is enhanced by one's brusque and mighty environment in witnessing the birth of another day, rather

* Felicia Hemans.

MOUNTAIN SUNRISE

than depressed by the consciousness that yet another has fled, the ever-increasing brilliancy of the picture heralding the coming of the glorious sun rather than his departure.

To witness the Alpine sunrise in its indigenous splendour, one should ascend a mountain summit, for from thence the phantasmagoric transformations in these evanescent *tableaux* rival anything to be seen on earth.

Perhaps one's ecstasy is raised to the utmost in witnessing sunrise on the mountains when in angry mood. This is difficult enough to attain, for usually the scene of cloud and turmoil is rendered the more sombre by the sullen heaping-up of leaden billows, their frowning forms oftentimes transitorily flashed into being by electric manifestation, when we seem to see "horsemen running in the air in cloth of gold, armed with lances, like a band of soldiers; and troops of horsemen in array encountering and running one against another, with shaking of shields and multitude of pikes, and drawing of swords, and casting of darts, and glittering of golden ornaments and harness."*

Or, again, as is more usual and too well known to the tourist, the mountain summit may stand at dawn bathed in a stagnant mist isolating it from earth and heaven. A truly wondrous sunrise is that to be watched when this expanse of mist, this

* The Book of Maccabees.

MOUNTAIN SUNRISE

terrestrial ocean of cloud—opaque and welling—spreads itself far and wide, submerging the mountain, but sparing its crest. On such occasions one is indeed “high up in heaven above the clouds,” and we esteemed ourselves most fortunate when, on one occasion sleeping at the Gornergrat (10,300), we witnessed sunrise above the clouds.

Anxious lest we should miss the birth of dawn, we were on the mountain crest whilst night yet slept—night bejewelled by the watching stars, whose gem-like scintillations far outvie anything to be seen at lower altitude.

The vast canopy was of deepest, darkest cobalt, and so bright the stars one could discern shrouded in her white mantle the massy form of Monte Rosa, and near at hand the acute finial of the lofty Matterhorn; whilst far and wide spread all around the ocean of snow-clad summits, their virgin white crests just perceptible against the rugged-edged horizon, like white breakers on a blue sea. The beauteous star-spangled cupola was then evenly tinted, but as we watched we detected a pale blue brightening in the east, like a weird display—languid and lambent—of the ethereal fire of St. Elmo. Feeble though it was, it sufficed to quicken the sable blue of the whole heavens into steel-like azure, and, as it welled upwards and broadened, it suffused the whole eastern hemisphere with a weird brightening. Yet this was not dawn; it was but the *foreglow* of daybreak

MOUNTAIN SUNRISE

—a glow whose shimmerings brightened the heavens to cold steel gray, nor reached the earth, sufficing only — in twilight uncertainty — to disclose our summit, an island in a sea of dense tumbled cloud, around whose surgelike margin we now descry

“Needle peaks of chill granite shooting bare,
That tremble in e'er-varying tints of air.”

And now

“Great joy by horror tamed dilates the heart,
And the near heavens their own delights impart.”

Weird indeed was this blue-gray mountain world, and chill. We draw the blanket closer about our neck; we know that around our feet winds the python form of the frigid Gorner Glacier, with its acute *seracs*, its clefts and crevasses, but we see them not, neither do we see the giant boulders and rocky crags which by day thrust their great bodies, hard and asperse, through the soft folds of the eternal snow. Nor can we discern the lithic wrinkles on the broad mountain brow, the stony steepes arabesqued with snowy network, for we are in an ocean of raging waves, their foam reaching quite to our feet. We are in the trough of a boiling sea, itself hemmed in by snow-capped summits, yet, acute though they be, we can scarce disentangle terrestrial rock ridge from celestial cloud fringe. In the west the gray strengthens, and we make out that there at least the wave crests are of adamant. We

MOUNTAIN SUNRISE

look in another direction, expecting to make out the sharp, grotesque form of the dominating mountain, but her form is half hidden by a wool-like hood, and that strange striated collarette she so oft puts on, and which completely cuts her acute body into two.

From the summit of another mountain black streamers roll away, as if it were a vent from Hades, the blackness of the smoke-like cloud contrasting with the rapidly brightening gray as dawn neareth.

Fast indeed the glory rolls, mounting higher and yet higher into the realms of space, disdaining yet to kiss our world. The glory is of richest, ruddiest hue, and, as it speeds up into the eastern heavens, battles with the pale green-blue of the west. Ill-matched combat! for quickly is the weaker vanquished; the stronger, monarch of all it suffuses. The heavens now glow in vivid splendour. 'Twould seem the outer world were all afire, yet still the mountain summit stands chill and colourless. We look down upon the soft billows which all around us still lay cold and gray, when we are almost startled by the suddenness with which they become illumined with a soft pink light. We look upwards for the cause. There it stands in exultant majesty. The heaven-thrusting peak is bathed in a blood-red halo, its snowy cap "tinged like an angel's smile all rosy red."

The sun has kissed the mountain brow. And now quickly indeed do the entrancing transmutations

ALPINE SUNSET

follow, the one upon the other ; mergings arise but to wane ; evanescent indeed are the gorgeous colours now so rapidly painted into the indescribable scene, for—

“Suddenly quivers up
A flame in the east. The white sides thrill and heave
In a wave of gold, as if a chord had struck
Of a vast music, and we scarce can tell
If we see or hear, so fast the glory rolls.”

The golden shafts of the still invisible sun shoot



VI.

up into the heavens, wash off the blood from the summit cap, only to replace it with a golden crown, and just at that exquisitely supreme moment when he has filled the whole mountain world with a golden glory, he shows his own

golden corona above the crystal, sharp-toothed horizon.

So sudden his advent, so o'erpowering his brilliancy, one needs turn one's back upon him to view the glorious scene he has awakened ; to see his daily work commence, for—almost as in fear—the mists tremble at his on-coming, they dissipate, and, fleeing hence, open to the sleeping valleys a glorious *vista*—remnants of a mountain sunrise.

ALPINE SUNSET

Second only in splendour to the scene Nature thus ravishingly paints for us is the Alpine sunset, gorgeous, subdued reversal of the mountain sunrise ; a waning—welcome, yet regretted—of the ardent effulgence of the giver of all warmth and life. Little by little his too brightly incandescing face expands, little by little his golden countenance assumes a blush of red as he sinks to a level with the summits. His loss is first felt by the icy caves and crevasses, the snowy *couloirs* and the rocky gorges, the while he glints with gold each crest and *aiguille*.

Never do the mountains look more grand, more imposing, than when his waning casts dark mantles around their huge forms, and plants a golden crown upon their heads. Their majesty seems enhanced, for—

“When the sun bids the gorgeous scene farewell,
Alps overlooking Alps their state upswell ; whilst
Huge Pikes, of Darkness named, of Fear and Storms,
Lift, all serene, their still-illuminated forms.”

But, alas, how fleeting the coronation ! As we gaze the splendour of the gilding tarnishes to the hue of old gold, and this again merges to the brazen tint of copper. The valley which he has flooded all day long enchains his light no longer, the barren and angular mountain-tops become silhouetted against a cloudless sky, whilst his rays are suddenly bent heavenwards. His face is now hidden behind

ALPINE SUNSET

serrated ranges, but his golden rays—like angels' ladders—dart up straight-lined toward heaven, throwing the sky above the arid ridges into a halo of golden glory.

The angels of light have indeed fled up these golden ladders, for chill and deserted now lie the icy *glechers*, the rock-bestrewn gorges; yet the sombre-hued mountain crags, fantastically streaked and mottled, become suddenly lighted up with a brilliant amber, rapidly increasing in tone as the fleeing light deserts them. Alas! too transient, for while we yet admire, it leaves these noble earthly excrescences, and is alone reflected in ruddy splendour from the realms of space, where but an instant before space had been revealed by an ethereal canopy of fleckless blue.

Then cometh a short pause, and ere the glorious gradations of the Alpine sunset have faded from our mental vision, Nature, with imperceptible increment of chromatic splendour, commences to paint for us one of her most glorious, most admired pictures—the Alpine afterglow.

To attempt to convey in words the glory of the colouring were utterly futile. No camera ever constructed, no brush ever wielded, can do justice to Nature's own picture, nor reproduce with approach to truth the harmonious *éclat* of her colouring. Neither the one nor the other can reproduce the beauteous blending of Nature's own photograph. Our artificial colours may be "good enough for the

ALPINE SUNSET

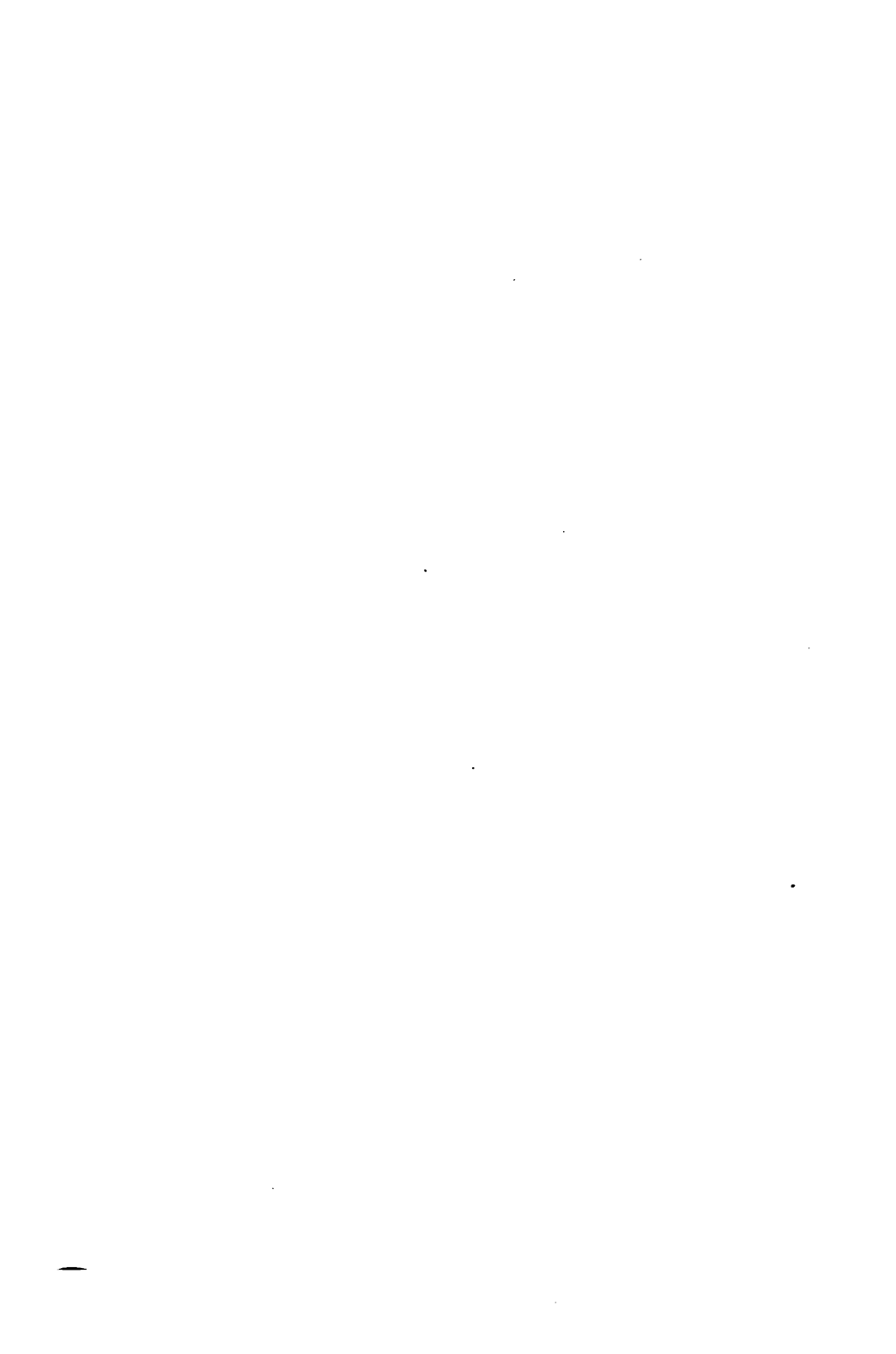
splendour of lowly pride, but not good enough for one wreath of perishing cloud, nor one feather in a wild duck's wing."

We stand here entranced and ask ourselves, What is this that spreads itself in transcendental loveliness o'er us? And when we answer, Nothing—nothing but the colouring of illimitable, incomprehensible, imponderable space, we shrink within ourselves at the thought of our own nothingness.

"For images of other worlds are there ;
Awful the light, and holy the air."

Ourselves—what puny semblances of something are we ! It is a saddening, a humiliating thought, quenching our arduous admiration, urging us to retrace our steps to things more mundane—to earth, more consonant with ourselves ; and passing downwards through those same zones of varied habitation, so diverse in their colourings, we are glad again to hold communion with "Nature's painters" in more kindly mood.





3



To Jane Chappell, III.

THE LACE-WORKERS

CHAPTER III

SWISS DAYS AND SWISS WAYS

“ For valour, faith, and innocence of life
Renown'd, a rough, laborious people, they
Not only give the dreadful Alps to smile,
And press their culture on retiring snows ;
But, to firm order train'd and patient toil,
They likewise know, beyond the nerve remiss
Of mercenary force, how to defend
The tasteful little their hard toil has earn'd.”



VII.

PONDERING upon the painters of Nature, we have wandered upon the green Alps, have clambered among the rocky *Aiguilles* towering above them, trodden the virgin snow-fields of the mountain crest, glad again, as we have said, to descend to lower altitudes; and thus at 5,358 feet we find ourselves again in this assemblage of timber huts, situated at the mouth of the

ST. PIERRE

interesting *Val-Sorey*, on the river of the same name, sheltering some 400 agriculturally - employed inhabitants, and known as St. Pierre, or *St. Pierre Mont-Joux*.



VIII.

It is a very ancient townlet, with a church dating from the eleventh century, and we feel it could well be taken as a typical example of a Swiss Alpine village.

As we roam through its narrow, tortuous, and timber-hemmed street, we are constrained to ponder upon the life and manners of the inhabitants of such far-removed villages, as well as those of the dwellers upon the mountain-sides.

When we may have surveyed this beautiful country from afar up upon the mountain pinnacles, where, as far as eye can carry, one sees nothing but a veritable ocean of summits, and when we shall



IX.

have passed through dozens of such villages and tiny *bourglets*, wherein we hear nothing but the tinkling of cow-bells and the drowsy clatter of hay-stuffed *sabots*, seeing nothing but old women staggering under the weight of bulky faggots of wood upon their backs,

SWISS INDUSTRIES

young women deftly balancing heavy milking-pails upon their heads, and men cracking their heavy whips to encourage slowly-plodding teams of horses and oxen to drag loads of agricultural produce, whilst others wearily return to their native *bourgs* from Alpine meadows, their scythes or other agricultural implements upon their shoulders, we might well be excused if we made the assumption that Switzerland possessed not an industry beyond that of agriculture, and that this was its staple.

How different, however, are the actual facts!—facts which speak eloquently anent the industry of its inhabitants! for, after France, Switzerland is the largest producer of silk goods and of cheese. After Great Britain, she is the largest producer of cotton goods and machinery, excluding America; whilst her hotel interests are said to be the largest in the world. In regard to her silk industry, we were informed that sericulture had been more than once tried, but it had failed.

One certainly cannot travel in Switzerland without being impressed with the magnitude of one of the Switzer's occupations, namely, that of hotel-keeping.* To convey some idea of this, we may add that it has been estimated that from January 1, 1899, up to October 31 following, no less than 2,500,000 tourists visited Switzerland, and that they each

* The value of Switzerland's hotels and inns is estimated at £13,000,000.

SWISS GOVERNMENT

left in the country an average of 80 francs (£3 4s.), or a total of £8,000,000. Inasmuch as the population of Switzerland is only 2,933,300, it is difficult to appreciate the significance of these figures. The *per capita* wealth of the country has hitherto been estimated at £2 18s. 4d., but the influx of money above referred to suddenly brings it up to £6 2s. 4d., or from one of the poorest countries (*per capita*) to one of the richest. Consul Ridgely, of Geneva, says that this would at least appear to be the result on paper, but, as a matter of fact, the sudden increase of the country's wealth is not so great as the figures would indicate, for the reason that Switzerland buys nearly everything she sells to tourists, including the supplies for the hotels and boarding-houses; and therefore, while a great deal of money comes into the country, a large proportion of it has to be paid out. However, the increase in the country's wealth from the hotel industry is obviously very great.

The Government of the country is democratic. Every man votes for his rulers, and can himself become a ruler. At one time each canton—of which there are twenty-two—was in reality a separate self-governing State, without any legal inter-communication; but these have been welded together for all national purposes, while still retaining much of their old freedom in local matters, for, generally speaking, each has its own Parliamentary Grand Council. Here, also, the Swiss show a good

SWISS COMMUNITIES

example to their Italian neighbours, for they by the strictest economy manage to keep their Government expenses, and hence their taxes, on a most commendably small basis.

Their laws are few, but they are and must be rigorously obeyed.

“These vales, these hills, have known no lord but law,
Since Freedom for this people first awoke.”

Thus, taking all in all, Switzerland is a contented and prosperous little country.

Though we are in a surprisingly healthy land for the visitor, yet the Swiss cannot be considered a typically healthy people, the percentage of the blind, dumb, and insane, as well as of ordinary disease, being high. Switzerland, indeed, enjoys the unenviable distinction of having a larger percentage of lunatics than any other country.

Whilst writing somewhat of the general characteristics of the Swiss people, we must call the reader's attention to the fact that in no country of Europe are so many local idiosyncrasies to be found as among the inhabitants of this mountainous land. The internal differences, the enmity and intermittent strife as between Canton and Canton, fierce and bloody though they were, are things of the past. Yet every valley has its customs, its habits, its ways of life.

There being two religions, three languages, and two

SWISS COMMUNITIES

dozen States, is it to be wondered that they differ so among themselves? How often are we struck by this fact on merely crossing a mountain ridge leading from one vale to another. Nay, more, a few turns of one's cycle-wheels will carry us from adjacent villages presenting not only distinct idiosyncrasies but distinct languages, many of the neighbouring villagers indeed being unable to converse with each other, this strange state of things



x.

arising, as we were informed, from the *patois* being so distinctive as almost to constitute a different language.

This is particularly noticeable in regard to the Rhone Valley, for at its head German is the language spoken, at its foot French, whilst through such transmutations do they pass that

even neighbouring *bourgs* have no language in common. Again, at the head of the valley this Valaisian district remains the most devout of all Switzerland as regards Roman Catholicism, whilst but a few miles lower down we find ourselves in the stronghold of Protestantism, as it has remained ever since the days when the "sword-like spirit"

SWISS PROCESSIONS

of the cold Protestant made his name* a portent and the world afraid.

Brieg, the townlet at the head of the valley, is, and has always been, the stronghold of Catholicism, having entirely withstood the widespreading influence of the latter doctrine. This was impressed upon us in strolling out to visit the church of the neighbouring village of Glis, and happening upon one of those extraordinary pantomimic processions, those degrading dumb shows, fortunately to be met with only in conservatoria of Catholicism, of which one sees so much and on so colossal a scale in the land just beyond the Simplon, in the shadow of whose great headlands its little churchyard stands. There, winding its way in sacred solitude along the trim walk, came a procession, composed chiefly of white-cassocked priests and white-veiled maidens.

“The cross, in calm procession borne aloft,
Moved to the chant of sober litanies.
Even such, this day, came wafted on the breeze
From a long train, in hooded vestments fair
Enwrapt.”†

A quartette of the lassies led the train, carrying upon their shoulders a light platform, upon which stood erect the effigy of the Virgin Mary, gorgeously apparelled and wearing a crown of gold, whilst she clasped in her arms the infant Jesus. By our side

* Calvin.

† Wordsworth.

THE SWITZER

stood a bright young American lady, keenly appreciative at once of the beautiful, the ludicrous, and the grotesque. From her shoulder there depended a little black strap, and from this, again, a little black case. Quick as thought, and much quicker than the passing mime, this was in action, and the procession taken. We reproduce it upon this page.

It is, moreover, remarkable how for ages one valley has kept itself from the influence of another, intermarriage between one another being almost unknown.



XI.

In Switzerland there is no aristocracy. The men either keep a business or work a farm; the women work out of doors, in the factory, or at home. There is nothing approaching what

is known as "society" in the land. Dinners and balls occur occasionally among the more wealthy, and the ladies will take afternoon coffee with one another in towns, but the men do not attend these. They are far too busy; but in the evening they may call in at the club or café and discuss business and the affairs of State.

We visited a number of textile and other mills and factories, but a description of these would probably not interest the reader. In doing so, it

THE SWITZER

was clearly noticeable that the physique of the workers therein fell short of that of the mountain dweller. The Swiss townsman and mill-hand is smaller, but bears the impress of health. With us it is otherwise. We can at once identify the Lancashire mill-hand or the Sheffield grinder, not alone by his stunted growth, but also by his sallow, healthless complexion. The tastes of the two *confrères* also differ, for the town-dweller, with more of tavern life and an occasional play, is a thought more lightsome and artificial than the mountaineer, who is at once simple, natural, and severe. The following lines accurately describe him :

“Jorasse was in his three-and-twentieth year,
Graceful and active as a stag just roused ;
Gentle withal, and pleasant in his speech,
Yet seldom seen to smile. He had grown up
Among the hunters of the Higher Alps,
Had caught their starts and fits of thoughtfulness,
Their haggard looks and strange soliloquies,
Arising (so say they that dwell below)
From frequent dealings with the mountain spirits.”

Although the reader might not care to accompany us into noisy and, in some cases, noisome works, to wind our way among the huge machinery engaged in engineering construction, and amid the whirr and rattle of the mules and looms of textile factories, yet we think a few words concerning an interesting

SWISS LACE

home industry may prove acceptable—we refer to the making of Swiss lace.

In exploring quaint and sleepy Italian villages* we shall find ourselves standing at *via* corners and watching the sun-bronzed lace-worker at her work—a pursuit which on that side of the Alps appears so well adapted to be carried on *al-fresco*. It is therefore interesting to reflect upon the entire con-



XII.

trast this same domiciliary occupation presents upon this side of the manner-dividing mountain-chain.

The Lombardian lace-makers doubtless existed long before the lace pillow was ever seen in the abode of the hardy Switzer, who himself at a later date trained him to occupy his long winter evenings with

* See "A Glimpse of Fair Italia," by the Author.

THE SWISS LACE INDUSTRY

this delicate work. Moreover, in Italy we find the industry confined principally to the lowlands; whilst here in Switzerland it is more of a mountain industry.

The principal seat of the Swiss industry in years gone by was the mountain village of *St. Croix*,* in the Jura chain, and in this relation it is interesting to note that it was undoubtedly introduced there by the Lombardians.

The first inhabitants of *St. Croix*, according to the *Chatelnerie*† of *St. Croix*, preserved at Turin in the archives of the House of Savoy, were the Mermods, the Junods and the Bornands, who were living in Turin about the year 1150. These names have survived, and it is Mons. L. P. Mermod,‡ of the present firm of Mermod Frères, to whom we are indebted for much interesting information, more especially that regarding the manufacture of musical-boxes, upon which he is such an authority. Moreover, Louis Mermod, father of the four brothers constituting the present firm, it is interesting to note, took a prominent part in the introduction of the lace industry, himself employing between the years 1810 and 1836 several hundred *denteleuses*.

How the industry came to migrate northwards is interesting. It must be borne in mind that the Jura chain was, and in places still is, a densely-wooded one, and it was the product of the forest

* See Frontispiece to Chapter VII.

† The archives of the church.

‡ See Chapter VII.

THE SWISS LACE INDUSTRY

upon which the inhabitants first subsisted. This gave rise to its colonization by small groups of foresters. Then came—in the eighteenth century—a certain amount of iron-smelting. This denuded tracts of the densely-clothed mountain-side, and then, as a natural sequence, followed the raising and care of cattle, and a small amount of agriculture upon the clearances thus made. The iron manufacture appears to have died out about the commencement of this century, the blast-furnaces of *Jouguenaz* being blown out in 1780, whilst the utility of those of *Bus-de-Noirvaux* was suddenly put an end to by a flood in 1812.

Up to that time tree-felling, charcoal-making, ore-winning and iron-smelting had formed the work of the inhabitants—work of the most arduous nature by reason not only of the callings themselves, but also of the mountainous nature of the ground and the terrible apologies for roads then existent, or coming into existence by the brute labours of man and beast. Forestry therefore declined, and the work of the mountaineers became purely agricultural.

But agriculture is not to be pursued at such great altitudes all the year round, and if followed as a summer occupation only, it would require to be unusually lucrative to enable the workers to subsist in comfort during the long winters. But these *brusque* occupations were to give way to industries presenting the greatest possible con-

THE SWISS LACE INDUSTRY

trast to them, for towards the middle of the eighteenth century a new industry sprang up in the district of Neuchâtel, and this was entered into with avidity by the persevering and industrious inhabitants of the little town to which we have referred, this *St. Croix*, doubtless at one time merely the site of a rude cross set up in the woods near the mountain summit.

The industry introduced here in the Jura Mountains—as a winter occupation and to serve as a stop-gap—was that of lace-making. Naturally, from its *genre* the women—especially the younger of them—were the first to take to it. They were, however, soon followed by the younger men, and although the intricacy and *finesse* of the work and the delicacy and the skill called for was in such contrast with the outdoor occupation of the men, still, it is easy to see why they should also have taken it up, when we consider the lengthy hours of winter during which they were unable, by snow and darkness, to follow their more ancient avocations.

We all remember how George Stephenson, the great engineer, by watching the busy needle and skilful fingers of his wife in his evening hours of relaxation and reflection, became a needleman of no mean merit, and how in the evening of his own years he on more than one occasion astonished young ladies similarly occupied in their drawing-rooms by giving *them* lessons in the art more usual

DENTELEURS AND DENTELEUSES

to their sex and to their own more delicate fingers. So it is easy enough to conceive how the sturdy and steady young husbandmen of the Jura Mountains, spending their evenings alternately in singing and in puffing clouds beside their sisters and sweethearts, should have followed 'Geordie's' example, and themselves learned the art of lace-making, and themselves become *denteleurs* under the tuition of their fair companions, the *denteleuses*. Moreover, it is easy to conceive, when we reflect that such occupation spelt money to them, that in but a short time the *coussin à dentelles* was to be found in almost every cottage of *St. Croix*.

A very pretty picture such evening occupation presents to us. Instead of a family idly and dolefully counting the hours of enforced inactivity, bewailing the harshness of the elements, the abnormal inclemency—imaginary or real—of the winter, and retiring to rest dissatisfied and sadly, this could we have seen as the interior *tableau* of one of these rough and uncouth wood *châlets*, with its roof piled up a *metre* deep in snow, its door forming the end of a deep cutting giving access to the centre of the steep street, itself consisting of nothing but a spade-cut trench in the deep, pure white snow, so that passers-by could not even be seen, and by which alone the forester who had sledged a few pine-trunks down into the valley could regain his log-spread hearth.

SWISS LACE-WORKERS

Thereon we see the ruddy embers of the fir-logs and great larch clippings, ever and anon brightened up to an ardent red by the fitful draught, responding to the rushings of the fierce wintry blast over his timber chimney, and which could be heard howling and whistling without, catching up in its chill and invisible fingers, and hurling and whirling in circles and wreaths on the bleak sides of the *Great Chasseron*, the crisp snow, which rises and falls and glistens like foam in the frosty brilliancy of the winter moonlight.

There—in the room forming kitchen, parlour and bedchamber, as neat and scrupulously clean as it were possible to picture it, with its white ceiling-boards and walls, its red-tiled floor, and its brazen utensils, so bright that they do efficient service as spherical mirrors—stands in the centre of the floor the small round table, upon the centre of which flames (somewhat noxiously) the *craisa*, a lamp giving a bright white light from the burning of a mixture of tallow and oil. Sitting around the table we see two girls and two men, a glance at whose countenances suffices to tell us at once that the two former are sisters.

The elder of the two girls wears an expression at once more intent and more serious than that of the younger—more intent because she is the elder and the counsellor, and even now is reflecting that certain rent and other payments are becoming due,

SWISS LACE-WORKERS

whilst the lengthening of the lace does not make such appreciable progress as to remove the look of care—more serious because she, too, is a mother, and the laboured breathing of a little one, shaded from the lamp by a red-white table-cover depending from a couple of nails in the ceiling beam, raises fears in her mind more compatible with a perturbed than a placid countenance. We notice that the Switzer at the *coussin* opposite to her—a handsome fellow with dark hair, thick burly eyebrows, and a somewhat aquiline and Italian cast of countenance—is as intent upon his “piece” as his wife.

We note, too, that the younger sister, with her bright smiling face and her very roguish eyes, seems to be able to command and control the rapid movements of her deft hands and flexile fingers quite without the aid of those brightly-twinkling orbs, which appear to be set a-smiling by the contemplation of the laboured movements of a pair of rough hands belonging to the younger man opposite. His face is intent to absorption as he peers down upon his brightly-lighted cushion: for in front of each operator stands a large glass sphere, or *kügel*, filled with clear water, by which the light of the lamp is concentrated and thrown brilliantly upon the all too slowly growing lace affixed to the cushion, pinned there upon a lightly-traced pattern.

Each worker has her or his *coussin*, across which lie the numerous fine silk threads, terminating in

SWISS LACE-WORKERS

such a bundle of bobbins as to render it impossible for the uninitiated eye of the ordinary mortal to pick out any particular or individual one. Every now and again we see that our diligent, albeit sluggish, worker, with a little sigh of relief, allows his apparently innumerable bobbins to rest whilst he looks dreamily across the table, and then every trace of effort and solemnity flies from his features by reflection from the happy face before him, at which transformation a little ripple of a laugh and a *wie getz* escapes from the happy girl. We need scarcely tell the reader that *he* is *her* pupil, and that *she* on Christmas Day will be *his* wife, and the old folks will be there to see.

But where are they? There, so close up to the rough chimney jambs and overshadowed by the high and beetling mantel-board that we had hardly noticed them. There on one side of the gaping fireplace, a large white cap tied under her chin, sits grandmother, mother, and mother-in-law in one. Her fingers, though her eyes are no longer fit for the intricacies of the lace cushion, are not idle: the four long, bright needles, embedded in the steadily-growing drab stocking, flash still quickly in the bright ruddy rays, as quickly and with as little aid of eyes as they did when she, a mountain maiden, was set to watch and limit the leisurely peregrinations of Liza, the cow—ah! so many, many winters past.

SWISS LACE-WORKERS

Her eyes scarcely ever rest on her work ; they stray instead alternately—from behind a pair of great round spectacles in horn frames—from the bright-faced girl at the table to the contented, grizzled face of the stalwart and once handsome forester at the opposite side of the chimney, sitting in a rough high-backed chair and looking intently into the glowing ember logs, where he sees them—huge trunks—sliding down the steep mountain-side from a burst dam, engulfing poor Fritz, his younger brother—yes, five-and-forty years ago—dealing to him the heaviest blow of his life ; for it was he who built the dam, and deemed it sufficiently strong. His slow, far-back thoughts cause the great long whiffs from his huge pendent pipe to come at unwontedly long intervals, and to escape from below his iron-gray moustache with unusual deliberation.

We can just see enough of the old lady's eyes from behind the disfiguring *lunettes* to note that when they look towards Iselle and Antoine they shape themselves into a twinkling smile so much like Iselle's own. Then her thoughts are vacillating between the village church of *St. Croix* forty years ago and what it will look like on Christmas Day. When she slowly turns her head towards the old man, we see her eyes and countenance take a more thoughtful and more serious expression, exactly like that of the elder daughter, so quietly bending over her cushion there. Still more serious is it as her aged ears catch

SWISS LACE-WORKERS

the sound of the baby cough from behind the table-cover curtain yonder.

And so, like the horological work of *St. Croix* itself, does the clockwork of humanity move ceaselessly. Here is a mechanism, by mere age and diurnal wear and tear, irreparably stopping and losing its utility; there is another to replace it. It may be a perfect mechanism; it may be one of lesser perfection of construction; it may be one so strong and so adjustable as to give neither trouble nor call for repairs; it may be an agglomeration of parts, wondrous and intricate, like those of the wee one there whose main-spring ventriculates all too feebly, which for all its existence may give cause for solicitude and constant trouble. And so, swiftly, ceaselessly, like the recondite mechanism of *St. Croix*, does the great mortal clock of the universe move ever on.

Let us walk a few steps farther between the glistening snow walls high above our heads, with the fresh-fallen snow grating and cracking crisply beneath our feet, to peep through a shutter crack into the timber *salon* of the little village *auberge*. There we see another round table, another brightly-burning lamp, another circle of glass-light-converging spheres, another circle of smiling faces, their owners all at work. At an adjoining table are half a dozen old men playing some game of cards, different to ours, and which we cannot understand: down go

VILLAGE EVENINGS

the cards with a thud one after another, and down go the scores, for they are chalked on the age-darkened table-top.

Just now they are very quiet, for an old mountaineer, with a bushy beard and grizzled face, is singing a national song, the while beating time for himself with his long pipe, which he holds by the bowl and waves baton-like from side to side before his face. Now as a signal he waves it in a circle above his head, and all the lads and lassies round the lace-work table there, without desisting their labours, join in chorus, which by the harmonious merging of the clear *soprani* of the girls, the robust *baritone* of the swains, and the very grave *bassi* of the old men, is far from unpleasing.

Thus did the lace-making industry of *St. Croix* go on, an occupation which happily meant not alone harmless amusement, but bread and cheese, and, indeed, something more, for we are told that the *gentilles dentellières de St. Croix, les plus habiles*, could earn as much as 15 *batz* per day, and even more, but an average worker—and the men—made some 4 to 6 *batz* a day.

Domestic industries have one serious objection over factory labour—there are no set hours. The work lies always before the eyes ; that work means money, hence it is persevered in, in season and out of season, for the love of gain overcomes all consideration of hygeia. Hence it is on record that,

SWISS LACE-MAKING

during the years 1816 and 1817—which years our fair readers may perhaps be able to connect with some exceptional “lace” seasons—in many of the chalets of *St. Croix* the pillows and the bobbins were never allowed to rest, neither by day nor night. The household, so to speak, was divided into “shifts,” the one set working until midnight or one in the morning, being replaced by the others who had slept from six or seven in the evening as the former ceased wearily, to seek their well-earned repose; for, as the historian says at that time: “*On n'avait pas encore l'inspecteur fédéral des fabriques.*”

The first Friday of each month brought with it a little green sack garnished with crowns, when a chosen few of the *denteleuses* had paid their respects to the Neuchâtel lace merchants, handed in the result of their diurnal and nocturnal labour, and received their *écus*, together with a new design, on which was written the price to be paid for the work, just as a British barrister receives his brief with the amount of his “retainer” marked upon it. This they could accept or decline according to their estimation of the amount of labour entailed and the possibility of the demand falling short of the productive power of these mountain lace-making hamlets.

Man's brain, however, in regard to this industry, as in the case of several others, was destined to devise mechanism which should eventually convert it from an essentially manual industry into a purely

MECHANICAL v. FLESHY HANDS

mechanical one. Such machinery, it need not be said, was the object against which the vehement maledictions of the workers were levelled. In its infancy it was alone able to weave the simple *tulles*, but afterwards, by perseverance and improvements added to the looms, the tulle was made to receive figures, whilst to-day, so exquisite and so recondite have the *perfectionments* become that the laborious work of the deft hands of the industrious *denteleuses* can be carried out in almost its full beauty by the unwearying fingers of machinery, directed by the ever-revolving and design-changing mechanical brain represented by the punctured "Jacquard" cards swinging intermittently above the head of the almost thought-free operator.

Many happy hours are passed away in singing by the industrious workers, who are as simple in their pleasures as hardy in their labour. One can well imagine them during these long winter months, when evening comes, and



xiii.

"The inmates cheat the hours with song, yet pant
For the young Spring, to tread the flowery
grass,"

that long-looked-for and cheery season
when

"The long dark winter nights are o'er,
And cattle in their stalls no more
Need linger,"

A SWISS RECOUNTAL

relating some of the old tales that have been handed down for centuries amongst them. These are highly imaginative, the fulcrum upon which they turn being usually a vision seen by their forefathers.

“ In the long winter here how oft is told
The tale of mountain spirits, who still haunt
The raging torrents brawling down the pass,
Or wait in fear upon the giant gaunt,
Who lies encavern'd in some dread crevasse.”

We give the following,* which is, indeed, one of these same superstitious recountings, as being typical of many which the simple Switzer peasant will recount to you if you visit and converse with him in his dwelling :

“ A herdsman was on a wet and murky day seeking a stray cow in one of the wildest districts, where only glaciers and bare rocks are to be seen, and was astonished at meeting a lady walking towards the glacier. He quickened his pace with the object of offering her his services in case she might have lost her way. As she drew nearer he noticed that she was young, beautiful, and of noble birth ; but what surprised him most was that both her head and her feet were bare. From her magnificent hair, which fell in large ringlets over her shoulders, the raindrops trickled ; a gold chain adorned her fair neck ; her slender waist was encircled by a valuable girdle, and her arms were embellished with gold

* “ Concerning the Bernese Oberland.”

A SWISS RECOUNTAL

bracelets ; rings set with diamonds glittered on the fingers of her small, snow-white hands ; her bare feet, red with the cold, seemed so tender that every pebble must have bruised them. With one hand she modestly lifted her silk apron, which else would have impeded her steps in this rough region, and in the other she carried a long staff. She trod so carefully with her delicate feet on the hard, cold and wet stones that it was easy to observe how arduous and painful every step she made must have been to her. Her lovely countenance bore traces of much weeping, while fresh teardrops still glistened in her large mild eyes. As she walked there escaped from her finely-formed and coral lips gently murmured sighs and prayers.

“ Filled with astonishment at this remarkable apparition, and moved with deep compassion, the herdsman thus addressed her :

“ ‘ For Heaven’s sake ! fair lady, how came you into this wild region in such rough weather ? You must have lost your way. Mercy on us ! you are walking barefoot, without hat or cloak ! Surely you must have met with an accident. Where are your attendants ? Did you not take a guide with you ? You cannot have come here on foot. No doubt you alighted from your horse not far from here, and have wandered away from your attendants alone and lost your way.’

“ ‘ No, good youth, answered the lady in a gentle

A SWISS RECOUNTAL

voice, 'I have not lost my way ; I have, indeed, come here without attendants, without horse, without companion, without hat, shoes, or cloak. I have just come from a splendid palace in a great city. My body still lies in Milan on my death-bed, and my poor parents are weeping bitterly for their only daughter, bathing her corpse with their tears. God has condemned me to do penance in this glacier because during my lifetime I scarcely ever set foot to the ground, since I always drove out in my carriage, never treading the hard stones. I never left home without numerous attendants, never exposed myself to a breath of cold air, never denied myself an innocent pleasure, and shunned every exertion and fatigue. As a punishment for my daintiness I am compelled to go barefoot in this rugged wilderness, to walk in rain, cold and stormy weather, and to do penance on this glacier. This is my purgatory ; yet beyond this daintiness I have done no wrong.'

" As she finished speaking, a cold shower of rain began to fall, and a dense, dark mist hid the lovely maiden from the herdsman's sight. When, after a few moments, the rain had ceased, the dense fog had cleared away, and the weather brightened up a little, no trace of the beautiful lady was visible to the bewildered Alpsman. Instantly, but, alas ! too late, it occurred to him that God had not permitted her to appear to him in so beautiful a form without

A SWISS RECOUNTAL

an object. Certainly but little was wanting to effect her complete deliverance. Oh, if only, instead of his useless questions, he had offered her his assistance for accomplishing her redemption !

“ He now called aloud repeatedly at the top of his voice on the spot where she disappeared :

“ ‘ Beautiful lady, oh, pray tell me how I can release you !’

“ But the answer that came back was only the echo of his own words ; the icy streamlet continued its melancholy flow ; the glacier thundered ominously in its depths ; pale, vaporous forms rose from the fissures or sank into them ; but of her he saw nor heard never a sign. Often, when impelled by an inexplicable longing, he betook himself through mist and rain into this desolate region, taking his seat on the ground where the delicate feet of the beautiful lady had touched it, with his face turned towards the place whence she had vanished, and while recalling once more her lovely face, he would cry again and again with a loud voice : ‘ Oh, beautiful lady ! can I do nothing to deliver you ?’ The rock, however, returned only the same faint echo as before. Often the same dense, dark mist and cold, drizzling rain would envelope him, the brook still continuing to flow on with the same melancholy murmur, the hollow thunder of the glacier resounding as before ; all the surroundings remained just as wild, and from the fissures of the glacier pale misty forms rose as

SWISS DAYS AND SWISS WAYS

of old ; but, to his great sorrow, he never more beheld the phantom form of the beautiful, the unhappy Milanese lady."

Verily

"The restless world may toil and strive
And change from day to day,
But mountains and the mountain folk
Remain the same for aye."

Surely such beautiful superstitions as these can do no harm to the simple-minded Frenzels and Gretchens of mountain and valley. Nay, if they embody a moral, such as does the foregoing, and if their recounting serve to perpetuate such wholesome feeling, they can do but good—good to the dweller, in purifying his ideas, even though, as the poet says, they may "croon *thought* to sleep"; good to the traveller, because they throw a "divine enchantment o'er the scenes."

"But what is this, lighter than infant's breath?
No mist, nor voice, nor viewless herald's touch,
Yet sure some Presence rises!
Breathing its divine enchantments o'er the scene,
Dimming bright reason's eyes and crooning thought
To sleep."

What can it be that fills even the transient traveller with romantic thoughts and desires, which as we explore the heights keeps us on the tiptoe of

THE SPIRIT OF THE MOUNTAINS

expectation, which throws a glamour over all our surroundings?

“ It is the Genius of the hill—
The Spirit of the peak, who ne’er descends
To disenchanted leas, but here at home
A dainty Ariel and delicate
Sways glimmering, wavering, whispering everywhere— ”

In reading the pretty *saga* just recounted, it will be observed that, like most of the mountain legends, it carries a moral, and in this case a reflection comforting to the mountaineer in his isolation from the more artificial pleasures of the town-dweller, in that it foreshadows to him the possibility that his simpler habits and earthly denials may find recompense in an after-existence, whilst to those who shall have enjoyed them here shall they be denied.

As we get more into the higher mountains, the inhabitants get, though more hardy and self-reliant, yet more devout and more superstitious. Volumes might be written of their *sagen*, or local superstitions, traditions, and legends.

“ High up on the mountain lone
Mythic voices lend a tone
Charming, with the sense of love,
Earth below and stars above.”

What could be more conducive to simplicity of mind and manner than the long hours of solitude the shepherds and goatherds spend high up upon the solitary Alps?

THE SENNERHUTTE

“Calm and bred in ignorance and toil,
Each wish contracting, fits him to the soil.
Cheerful at morn he wakes from short repose,
Breathes the keen air and carols as he goes.”*

And this applies to both sexes, for the agricultural operations at high altitudes are largely carried on by women. The tending of goats is usually allotted to the little Alpine boys, or *gamins*, the older women watch the circumscribed roamings of the cows, whilst the more arduous work of milking the latter, and of butter-making, and also of cheese-making, devolves upon the girls, or *sennerin*.

We will, however, leave the industrious *senner* busily engaged within her *sennerhutte*—a low, shed-like abode built entirely of rough, unhewn timber, its roof pinned down by small larch-trees, and further weighted by heavy stone boulders placed upon it to prevent it being swept off by the blustering winter winds—and descend to the foot of the mountain.

Here at St. Pierre we are at the head of the valley and the foot of the pass, before climbing which we are pausing to say a few words about Swiss days and Swiss ways. The villages we have passed through have been quaint and interesting, but they



XIV.

* Oliver Goldsmith.

ITALIANIZED SWISS BOURGS

must not be taken as exactly typical of Swiss *bourgs*, for their proximity to the pass has caused them to become somewhat Italianized. This effect is still more noticeable in regard to villages on the route of other passes.

For example, in the valley of Airolo and again at Brieg, at the foot of the Simplon Pass. There we see substantial houses in white *stucco*, with green *jalousies*, just as we saw them in passing through *Sembrancher* (see Photo II.).



xv.

Moreover, there are houses in rows and with heavy masonry - piered colonnades beneath them, as, for example, at Morat (Photo XV.). Such a thing is never seen in an essentially Swiss *bourg*.

In them all is wood, all is disjointed, all is irregular and delightfully higgledy-piggledy, as we see them in our photo (XVI.) of Zermatt. One thing the two have in common, however: every *châlet* and every house is in dual occupation—downstairs the cows, upstairs the family.

To see such typical villages, however, we must keep more to central and northern Switzerland, or the passes which give towards the Tyrol instead of to Italy. One of the most delightful walks we know of is from *Meyrenge*n to the glacier of the

TIMBER TOWNS

Rhone, over the *Grimset* Pass and the Gletch, in mounting which we may rest at what we should consider an essentially Swiss Alpine village. We refer to the pigmy *dorf* of Guttannen.

Here we find an assemblage of genuine Swiss chalets nestling together, in dangerous proximity in case of fire, with their gently-sloping roofs overhanging by several feet their weather-stained fronts. Having climbed hither from Meyrenge, we are entitled to a short rest, and while mine host of the "Bear" prepares a little "something" for us, we may look round the wooden village.



XVI.

Timber and nails are about all it has taken to build its quaint and roomy cottages. The *zimmermann* is about the only artisan required hereabouts. Their very roof tiles are of wood—if this be not an Irish bull—ay, and even their chimney-pots. Their chimneys have no "withes" to prevent rain from falling on the fire, and their capacious mouths might introduce an inconvenient quantity of snow were it not that they are provided each with a little wood-

A PIGMY CHURCH

shingled roof, hinged like a box-lid to one side. This lid has a tail-piece or big overhang as counter-balance, and upon this wooden projection is tied a bit of tree-trunk or a heavy stone to act as counter-weight, so that the chimney-tops remain open of themselves except when closed at night by the pulling down of a wire hanging within the chimney. The houses, though of wood, are very substantial, and, by way of ornament, we find here and there a little bit of poker-work, a member formed by nailing on a serrated board or a bit of moulding *dentée*.

The cottages exhibit a charming variety, and in their midst stands the weeist of wee churches we have met with. We fear it would take the palm from tiny St. Lawrence in the Isle of Wight, or even the dear, wee pigmy church of Perivale-by-Ealing. But Perivale has but its tower of weather-boarding! As for itself, it is of stone, and ivy-clad, of ornate interior and venerable. Guttannen is neither, nor is it venerable, for we read on its wood-shingled, extinguisher spire, with its tin-covered seams, the date 1870.* Its churchyard—we cannot say God's acre—is of the smallest. A good-sized counterpane would cover it. Its wee tower contains a tiny clock *en suite*, perhaps some fifteen inches diameter of face; but that matters little, for its most

* We learnt subsequently that the body of the church was older.

GUTTENEN v. LONDON

useful timepiece is its mellow bell. This it is which sounds the "morning hour," the mid-day "repast," and the evening's "cease from toil." It is ringing now, for it is twelve noon, yet it is not for service.

Of timber is the church, of timber also is the hostelry. Up timber steps we find the timber threshold, and what a solid one it is! 'Tis best to step *over* than *on* it; then we are less likely to "head" the timber transom, for the doors are wondrous low. The common room* is timber—floor, partitions, ceiling, all; and all alike are scrubbed with scrupulous care. One might break bread on any plank of it. On timber forms we sit, unless we prefer the timber bottoms of splay-legged chairs, whose straight "timber toes" are morticed up through the hard timber seats in a manner uncomfortable to the cyclist's—taste.

The bright and rosy face of our landlord's daughter is good to look upon, for, although it had spent a year or two—for educational reasons—close to London, the time had not sufficed to dull the bright colouring in which the Alpine artist air had painted it. She preferred, she said, "Guttennen to London;" which comparison—the former is a mere wooden dolls' village, which could be transported and re-erected in a single shop of our colossal Metropolis—reminded us of the quaint form of prayer solemnly offered up by the good presbyter of

* The hotel proper is not open in the winter.

SWISS CHÂLETS

those specks of islands to be found, if carefully searched for, just off the west coast of Scotland : “ O God, bless and preserve Thy people of the Greater and Lesser *Cumbræ*, and of the adjacent islands of Great Britain and Ireland.”

One usually finds these same wooden houses plentifully supplied with numbers of very small windows, which are often fitted with panels of wood made to slip downwards. These are for use in winter, when the biting blast hurls the snow from off the mountain-side in blinding wreathings around the homestead. The wood is destitute of paint or varnish, and, in those villages which have escaped fire and lived to become old, is browned to a rich ripe colour by sun and age.

One wonders why the houses are so large, till one is informed that in them two or three families are living in perfect peace and friendship, whilst where a house is occupied by a single family it is usually a heirloom handed on from father to son for centuries.

“ Their joys austere, their frugal style be mine ;
Low houses builded of rough wood or stone,
Raftered and panelled with smooth native pine ;
Here let me rest heart-whole, nor rest alone,
High thoughts be my companions.”

The outlying châteaux usually have each its little garden wherein potatoes and cabbage—both playing a large part in the staple diet of the occupants—

SWISS CHÂLETS

are cultivated ; but the *bourg* chalets have their patch somewhere near at hand in the valley. In the midst of this garden-patch, perched on a large flat-topped stone, one often sees the family beehive, a conical-shaped erection made of heavy braids of straw. Everyone travelling in Switzerland has partaken of, and thoroughly enjoyed, the production of the busy little occupants of these straw hives ; for one seldom sits down to a breakfast-table, with its queer red-and-white cloth spread, without seeing a goodly block of honey-comb before one.

One of the most striking as well as most useful features of a Swiss cottage is the stove. This is usually a porcelain cylinder some six feet or more in circum-



XVII.

ference, standing from floor to ceiling, white as the snow, polished like marble, and with bright brass rings binding it or its sides, for they are sometimes square. In the winter a few logs of wood, some sticks or charcoal, and more rarely peat, serve as fuel for this warmth-giver, the smell of the latter fuel being characteristic and very welcome as we pedal into such queer yet hospitable little *dorfs* with the thermometer eighteen degrees below freezing. We cannot say that these *calorifères*

CALORIFÈRES

distribute a great amount of heat, but the distribution is fairly even, and they have the advantage of keeping their warmth for a long time, so that in the morning, when half frozen, one can get warm by climbing up and lying at full length on the top of the larger kind. At least, this is what a Switzer would do, but we prefer a good run round in the snow without.

All the farms, like the villages, are small; the country is essentially occupied in feeding itself. The farmer grows enough for his own wants, and sells his butter, milk, or cheese in order to pay his rent and taxes and to procure clothes. Many of the peasants own their little tract of land, but these are seldom the better off for it; for a bad season, sickness, or other cause has usually led to a mortgage, and what they should save in rent has to be expended in interest.

The food of the peasant farmer, though better than in several of the adjoining countries, would not seem to be really sufficiently sustaining for the arduous labour required of him. Meat is the greatest rarity with him, and, strange to say, whilst the cows are worked, the oxen are stalled and fatted for sale for the consumption of the visitor. The farmer's fare consists of vegetable soup, black bread, potatoes, weak wine, milk, and poor coffee. What he lacks in quality, however, he would appear to make up in quantity, for he breakfasts at 6 a.m.,

PEASANT FARMERS

lunches at 9 a.m., dines at noon, tiffens at 4 p.m., and sups at 8 p.m.

The coming of the visitor — and this in vast multitude—has not done much to ameliorate the condition of the peasant. It may have added somewhat to his purse, but it has had the effect of sending up the prices of his requisites materially, for the demand so unnaturally increased has drawn heavily upon the scanty supplies produced in a mountainous land. The necessities of life have risen in price quite out of proportion to the benefit the peasant reaps from this influx.

Happily, the Switzer combines contentment with poverty. He is poor, but he knows his case is but the common one. The prepollence of contentment in his humble station is beautifully referred to by Goldsmith :

“ Yet still, even here, content can spread a charm,
Redress the clime, and all its rage disarm.
Though poor the peasant's hut, his feast though small,
He sees his little lot the lot of all ;
Sees no contiguous palace rear its head
To shame the meanness of his humble shed ;
No costly lord the sumptuous banquet deal
To make him loathe his vegetable meal.”

“ The most helpful and sacred work,” says Ruskin, “ which can at present be done for humanity, is to teach people (chiefly by example, as all best teaching must be done), not how ‘ to

SWISS PEASANTS

better themselves,' but how to 'satisfy themselves. . . . And in order to teach men how to be satisfied, it is necessary fully to understand the art of joy and humble life—this, at present, of all arts or sciences, being the one most needing study. Humble life; that is to say, proposing to itself no future exaltation, but only a sweet continuance: not excluding the idea of foresight, but wholly of foresorrow, and taking no troublous thought for coming days; so also not excluding the idea of providence or provision, but wholly of accumulation;—the life of domestic affection and domestic peace, full of sensitiveness to all elements of costless and kind pleasure;—therefore chiefly to the loveliness of the natural world."

The pursuit of husbandry, undoubtedly, has a tranquillizing effect upon the toilers, frequently imbuing the agricultural worker with a spirit of much-to-be-commended contentment.

" At night returning, every labour sped,
He sits him down the monarch of a shed;
Smiles by his cheerful fire, and round surveys
His children's looks, that brighten at the blaze;
While his loved partner, boastful of her hoard,
Displays her cleanly platter on the board;
And haply, too, some pilgrim, thither led,
With many a tale repays the nightly bed."*

Only those travellers who may have visited this

* Oliver Goldsmith.

THE SWISS LABOURER

mountainous land when in its sternest mood, who may have wandered among the terrifying peaks in the solitude of the night, can rightly appreciate the value of such shelter, of such "nightly bed."

"The weary traveller, who all night long
Has climbed among the Alps' tremendous steeps,
Skirting the pathless precipice, where throng
Wild forms of danger: as he onward creeps,
If chance his anxious eye at distance sees
The mountain shepherd's solitary home
Peeping from forth the moon-illuminated trees,
What sudden transports to his bosom come!"

Equally pleasing is the effect agricultural occupation has upon women folk. It is sad to compare the effect of town life upon girls with that of the country. Contrast the brusque and mannerless demeanour of the factory girl, her low and sordid vulgarity, the coarseness, the uncleanness of her speech, her adoration of gaudy, "fashionable" finery, her love of unwholesome "outings" and excitement, with the rural simplicity of the country maiden.

Nay, more: the influence of country life suffuses the whole household. Enter the neat English farmstead or the Switzer's chalet: you might make pastry upon the white, scoured kitchen table; you might dine off the floor.

Glance at the snowy linen, the neat coverlets, the carefully-starched curtains, the elaborately-gaufréd cap surmounting the brow, with its carefully-

RURAL LIFE

smoothed hair, of the respectful housewife ; one sees at once that

“ Here reigns Content,
And Nature's child Simplicity, long since
Exil'd from polish'd realms. Here ancient modes
And ancient manners sway ; the honest tongue
The heart's true meaning speaks, nor masks with guile
A double purpose ; industry supplies
The little temp'rance asks, and rosy health
Sits at the frugal board.”*

Contrast, again, the effect the urban workman's tenement, the industrial flat, or the town slum, would have upon the husband of such a wife. In her rustic environment we fancy we hear her saying :

“ ‘ The milk is warm,
The cakes are brown ;
The flax is spun,
The kine are dry ;
The bed is laid,
The children sleep ;
Come, husband, come
To home and me.’ ”

She has been busy enough since her husband left her ; had we watched her all day, we should have seen that not a moment had she wasted. And thus has her time passed as profitably as it has pleasantly while she worked and sang.

* A. C. Brackett.

THE SWISS HOUSEWIFE

The Switzer *frau* also loves her home, and

“How sweet her cottage looks, with its broad eaves
And roomy gallery ! and what an air
Of real substantial happiness is there,
With neatness, too, combined !”

“Happiness is reflective, like the light of heaven, and every countenance bright with smiles and glowing with innocent enjoyment is a mirror transmitting to others the rays of a supreme and ever-shining benevolence,” says Washington Irving, and happily there are many so circumstanced as to be able to endorse this. Nevertheless, the true woman is seen at her best when sickness or adversity strikes at the happiness of the home ; for there is in every true woman’s heart a spark of heavenly fire which lies dormant in the broad daylight of prosperity, but which kindles up and beams and blazes in the dark hour of adversity.



XVIII.

If cleanliness be indeed akin to godliness, and good housekeeping a sign of a diligent and dutiful woman, then surely will the Swiss housewife be in *grande évidence* in the future state. She scrubs her

* George Keate.

A SWISS TROUSSEAU

boards—ay, and furniture—to the verge of annihilation. She is always at home and doing something for the home life. The husband may go off to his singing club or his shooting club, or down to the rural café, but, save perhaps for a Sunday afternoon excursion, madam remains at home with her neighbours, whom she visits on equality.

“’Neath her roof
No haughty lordling lives, keeping aloof
From his own kind because of lower birth !
Nor squalid wretches, miserable, lurk,
Foredoomed for others ever on to toil.
No, here she lives, enjoying life the while,
And works to live, but does not live to work !”*

With the Swiss early marriages are the exception, for in that land, and especially in regard to tillers of the soil, the struggle for subsistence is keen, and it takes long years to extract any pretence to a competency from the “churlish” soil.

Marriage is viewed in no lightsome vein by the bridegroom, and, indeed, even upon the side of the bride it would appear to be a serious business, for the amount of clothes comprised in a girl’s trousseau is simply enormous when compared with the British serving-maid’s, the preparation of the numerous articles usually taking years of labour to complete. Similarly, the bridegroom has an abundant supply

* James Cochrane.

SWISS WEDDINGS

of shirts and such-like outcome of the labours of the female members of his family.

The marriage customs of out-of-the-way places are often interesting, and many of them very quaint. We were sorry, therefore, to find that Swiss weddings presented nothing particularly picturesque, nearly all the old fashions having given place to what will soon be a very ordinary everyday wedding as seen among our own people. We observed two, in one of which a long procession was headed by a lady in white holiday attire, a long veil flowing down behind her head and shoulders. This was the bride. She marched proudly in front of all her relatives and friends of the female persuasion, who, also in gala dress, formed a long procession behind her. After them, however, came the mere men, the greater part clad, unfortunately, in their "best," which resembles the London workman's slop-shop Sunday suit. Amongst these, distinguishable by an enormous white nosegay in his buttonhole, was the bridegroom, looking not so proud and defiant nor so conquest-conscious. In this way the procession marched to the church, to return, however, in more orthodox fashion, those taking part having sorted themselves into couples.

On another occasion we saw a young man escorting a blushing maiden off to what afterwards we found out to be his home, amid the nods and pleasantries of his fellow-villagers. This, mine host

SWISS WEDDINGS

of the village *auberge* informed us, had been a custom with them from time immemorial—namely, for the man to fetch his betrothed home the night before the wedding and keep her there ready for the serious ceremony of the next day—a good custom, too, perhaps, for the groom was thus sure of having his lady at hand when wanted, and thus he would obviate a lost journey to church, which many a groom with us has had.



XIX.

A Swiss bride, we were informed, will permit no one on her wedding-morn—not even her parents—to kiss her upon the lips. A quaint wedding custom appears to be the pouring of hot water upon the threshold after the bridal couple have left, in order to keep it warm for another bride.

After marriage, their life, like that portion of it spent previously, is one of toil, but it is labour mingled with much conjugal happiness. As we

SWISS WASHING DAY

saunter down the village street at late evening we hear the young husband singing to his wife and friends, whilst during the daytime

“ So sings the mother as she milks within
The châlet near thee ; singing so for him
Whom every morn she sendeth forth alone
Into the waste of mountains, to return
At close of day as a returning soul.”*

Her children are always neat, and their buoyant health brings them contentment also. With her it is unusual to wash the clothes more than twice or thrice a year. By this we do not mean to infer that they wear them and change but semi-annually—as do some peoples—but they have such a very large stock of linen that a half-yearly wash will not cause great inconvenience. It must also be remembered that for half the year the younger women are absent from their villages, being engaged upon the mountain side. During this time the youngsters are left very much to themselves, but as soon as they can be made useful, as little yodeling goatherds they clamber up to the high-perched fields.

And with what labour have some of these fields been cultivated ! In many places the very ground has been carried in baskets up the mountain-side, and placed upon a flat ledge of rock in order to make a little pasturage not so big as one of our

* S. Dobell.

THE ALPINE MAIDEN

workmen's allotment gardens. And even when a scanty layer of soil is there to his hand, the frequent tillage causes it to work down and accumulate at the rocky edge, so that from time to time it has to be placed in baskets and carried upon the Switzer's shoulders again to the higher side. These tiny Alpen farms we see above us always remind us of the accidents which from time to time occur, and which, Mark Twain informs us, come about from the farmer incautiously leaving go of the handles of his plough and "falling out of his farm."

The irrigation of these little farms is often a matter of some difficulty, and one often sees little artificial canals and carefully-made little dams catching a fraction of the mountain torrent, and leading it to water little patches of garden or corn-growing land.

Let us, however, give a hint anent these buxom, strong-legged damsels we see beside us thus employed : Trust them not, reader, in matters of time and distance. If you be mounted on your machine and the distance to be covered *ten* miles, one will tell you you can do it in *ten* minutes ; the next will be less practical, and will say that "*Mein-herr Radfahrer*" can do it in *no time*. If you are walking, the best way is to multiply the time she tells you by two ; you will then just compensate for the effect of the mental calculation she has just made. For she thinks it would take *her* such and

AN INSCRIPTION

such a time ; but, out of compliment to Mein Herr, she feels *he* could do it in half that time, so that probably about half what she really thinks is what she tells him.

“ Our path curved round a wall of stone
With Alpine roses corniced, fair and sweet,
And there within its hollow, all alone,
 She stood with sun-browned feet--
An Alpine maiden with her simple store
Of berries, waiting on the rocky shelf
For travellers who should pass her open door ;
 And singing to herself
Some quaint old Switzer song, born of the sound
Of mountain-brooks from cloud-lost summits leaping.”

In strolling through the ancient streets of the little fortified town of Morat—as quaint as they are ancient—we observed upon the façade of one of the venerable houses—the former dwelling-place of a Swiss poet—an inscription to the effect that “ in the home must have its beginning that which is destined to illumine the Fatherland ” ; and we felt that the Switzer still continues to act upon this, for, as we shall see later, every effort is made to educate and enlighten the



xx.

SUNDAY

rising generation. But all cannot rise "to illumine the Fatherland," yet all may be patriots; and such assuredly the Swiss are.

"This peasant folk,
Comradely, frank, athletic; men who draw
Their lineage from a race that never saw
Fear on the field, but with firm sinewy stroke
Those knightly ranks, Burgundian, Austrian broke."*

There are certain sports indigenous to the country, as, for example, "lugeing"; but the native participates in them sparingly, leaving them for the most part to be enjoyed by the visitor. There are also occupations peculiar to the land. Amongst them we should not forget to mention the Swiss Alpine guides, a body of men hardy as they are brave, and in whom the Swiss idiosyncrasy of staunch trustworthiness—characterized in the celebrated "Swiss Guard"—stands out in laudable relief. It is noteworthy how the arduous and responsible duties of these guides, who week by week face death, have been from generation to generation undertaken by descendants of a few families.

Shooting and singing are favourite recreations, and for both purposes the Swiss form themselves into clubs. The Switzer is doubtless hot-tempered, and a wrong done is rarely forgiven, but lives to be revenged for all the man's remaining days. Yet in every-day life, as we have said, the Swiss

* J. A. Symonds.

SUNDAY MORNING

peasant is simple of manner. We can perhaps study him best upon the Sabbath, which he spends, to our mind, in a thoroughly rational manner, since it is divided about equally between devotion—for the Switzer is invariably religious—and recreation.

“It is a pleasing sight of a Sunday morning, when the bell is sending its sober melody across the quiet fields, to behold the peasantry in their best finery, with ruddy faces and modest cheerfulness, thronging tranquilly along the green lanes to church,” says Washington Irving; “but it is still more pleasing to see them in the evenings gathering about their cottage doors, and appearing to exult in the humble comforts and embellishments which their own hands have spread around them. It is this sweet home feeling, this settled repose of affection in the domestic scene, that is, after all, the parent of the steadiest virtues and purest enjoyments.”

So also is it very pleasant to spend Sunday in a Swiss village, for not only may we accompany the well-dressed villagers—and the Swiss always don Sunday clothing of extreme cleanliness and neatness, and such as would in many instances put to shame the slovenliness of our poorer popula-



XXI.

A SWISS SUNDAY AFTERNOON

tion—to their neat, simple, whitewashed village church, there to take part in a service, if it be in a Protestant canton, of almost severe simplicity, and if in a Roman Catholic one, of comparative simplicity, the males separating from the females, and occupying opposite sides of the aisles, each sex exhibiting a degree of devotion and attention which might well be copied on our side of the Channel, even by those who are not peasants; but after service we may attend the Swiss equivalent for church parade, which consists of a pleasant fraternizing of the men of the village with each other, all smoking huge pendant pipes and discoursing in studied slowness, whilst the women precede them, many clattering their great clumsy wooden shoes over the rough *pavé* of the solitary village high street. In the afternoon we may scale the steep mountain side in company with both, their neat dresses now enlivened—the men with a gay feather in their Alpine hats and a bunch of pretty red Alpenrose in their coats; the women with bunches of Alpine flowers plucked whilst climbing from the valley.

Above us, as we laboriously keep pace with the stream of chatting, happy villagers—who, despite the rapid pace at which they ascend, betray no shortness of breath as they laugh and oftentimes yodel in very effective style to their converging companions far away on the other side of the *thal*—we

THE SWISS AND THE PRIESTS

come into view of a roomy, Swiss-roofed and balconied *châlet*, from which, as we approach, the sounds of music, accompanied with a curious dull thumping, is heard. Entering the hollow-sounding timber structure, we hear also a curious shuffling noise, and, opening the *salon* door, find it is produced by the heavy-nailed boots of many a dancing Swiss swain and damsel thus happily and innocently passing away the Sunday afternoon. The music is that of a time-worn piano, of performers upon which there never appears to be any lack, but also between the dances the dulcet tones of the native zither may often be heard.



XXII.

Yet amid this Sabbath pleasure-making the Switzer must needs tend the pigmy flocks we see here and there dotting the verdure of the Alpen pasturages, and as we stood apart and surveyed this pastoral scene we saw that

“Down on the pasture-slopes the herdsman lay,
And for the flock his birchen trumpet blew ;
There ruddy children tumbled in their play,
And lovers came to woo.”*

* Bayard Taylor.

WALTER OF HALLYWELL

This afternoon entertainment is usually followed by an evening Alpine ramble, during which doubtless partnerships more lasting than those of the dance are declared ; and then, as the Alpine horns sound the *ranz des vaches*, in the summer twilight the industrious villagers descend again to their timber châteaux, to be again up betimes and at work upon their dew-covered Alps.

Service over, the village priest also is nothing loath to enjoy himself in a rational manner. Quite likely we shall see him sipping his opalescent *absinthe* upon the veranda of the mountain *auberge*, enjoying both the dance music and his cigarette.

The Swiss, though, as we have said, devout, are not so sadly priest-ridden as their neighbours either in Italy or in the mountains of the Tyrol,* nor is the monk in such *grande évidence* as we see him elsewhere upon the Continent, especially in the first-mentioned country. If, indeed, we are to judge from a legend which was recounted to us concerning the mediæval doings in a certain monastery of the Jura chain, we should not be led to assume that the Switzer's opinion of "good" friars and brothers was of the highest. The Castle of Hallywell furnishes the legend, which certainly does not redound to the credit of the good monks of the period.

Walter of Hallywell, as the youngest of three children, had been educated for the Church, but by

* See "Tyrolean Thals," by the author.

WALTER OF HALLYWELL

the sudden death of his brothers he, to his regret, was forced to leave the monastery he loved and was about to enter, in order to take up his position as Baron of Hallywell. Always preserving his deep interest in conventual matters, he married the daughter of a noble house of famous warriors, and she, his ladye love, it was who inflamed him with a love of martial glory, which decided him, at the age of sixteen, to leave the parental roof and find his salvation on the field of battle rather than in the walls of the monastery, which, indeed, would have been the wish of his father.

Two years later he returned from the wars, one of the few of his companions who had escaped with his life, and his father, always under the influence of the monks, desired him, as thanksgiving for his safe return, to make a pilgrimage to the Holy Sepulchre. His mother being dead, the young knight, in accordance with the only filial duty he now owed, set out once more.

Before his departure, however, his father presented him with the one half of a ring, the other half of which he retained, in order that, come what might, his son, by the production of the broken circlet, should be able at any time to prove his title. Years passed, and the sad news that his son had died in the Holy Land was brought to the pious lord of Hallywell. Feeling his years hanging heavily upon him, bereft, as he thought, of wife and son,

WALTER OF HALLYWELL

the old Baron made his testament, bequeathing all his property to the Church; but still he cherished some faint hope of his son's life, for he submitted the broken ring to the care of the monks, solemnly bidding them restore the entire property to its hereditary owner should he ever return to claim it. Shortly after the Baron rejoined his fathers.

Again years passed, happily bringing with them the return of the younger Walter, now Baron Hallywell, the report of his death having been but a false rumour. Changed in appearance beyond recognition, he still carried with him the mark of his identity, the last gift of his father, the title to his inheritance. Hearing of his return, the monks meekly professed their willingness to resign all claims if the broken ring should prove to be the missing half of the one in their possession, but—surprise of surprises—when the trial of its genuineness was made it was found in no wise satisfactory. The broken rims did not fit one another. This was a *dénouement* as serious as it was unexpected. However, a council was summoned to sit in judgment upon the matter, and it was decided to determine the identity of the claimant by single combat between himself and a chosen knight, in order that Heaven should demonstrate by the issue of the encounter the justice or otherwise of his pretensions.

In this combat Walter of Hallywell was victor, and, his claims to the property thus firmly estab-

A SWISS FUNERAL

lished, he resumed his rights, the monks being unable to lay any further obstacle in his path.

Alas for the sincerity of the holy fraternity ! it is recorded that one of these said monks—a holy father, doubtless often enough a confessor—when on his death-bed, *confessed* to having substituted another and spurious ring in place of the original, and this by order of his superior.

As in many other countries, Sunday is the day frequently chosen for the laying to rest of the departed and the performance of the sad rites attendant upon the inevitable function.

A Swiss funeral is devoid of the pomp and display of Italy and other countries. One we saw struck us as being peculiar in some of its features. Being a Protestant ceremony, only men attended, the women remaining at home. It appeared that regular invitation-cards had been sent out to the relatives and more immediate friends. These either attended in person or sent a wreath with a polite note of condolence. The *cortège* proceeded on foot from the house to the little churchyard, reverently following the coffin, a plain and simple box covered with black cloth. The service was very short, and when finished all dispersed to their respective homes. The rites would be fulfilled by the appearance in the local paper a week afterwards of a little paragraph thanking all for their attendance and sympathy on this sad occasion.

THE SWISS CHURCHYARD

The burial-ground of the Switzer is the fraction of a God's acre around his cold white church. And what a comfortless, barren, and white-walled little burial-place it is!—no clean white tombstones telling of recent bereavement, no lichen-grown ones speaking of revered and aged memory. Where is the soft green grass, the neatly-tended flowers of the English village churchyard; where the sombre, dark-leaved ivy, creeping slowly to cover the fresh-turned, flesh-chilling clay; where the graceful willow silently shading and weeping o'er all; where the



XXIII.

soft velvet moss, inviting us to recline and to reflect? Restful mosses, meek creatures! "the first mercy of the earth, veiling with hushed softness—creatures full of pity, covering with strange and tender honour—laying quiet finger on the trembling stones to teach them *rest*."

When all other service is vain, from plant and tree, the soft mosses and gray lichen take up their watch by the headstone. The woods, the blossoms, the gift-bearing masses, have done their parts for a time, but these do service for ever. Trees for the builder's yard, flowers for the bride's chamber, corn for the granary, *moss* for the *grave*.

Here in the Swiss God's acre we have nought but

BINS OF BONES

ugly crosses of wood or iron. If of wood, they are usually painted white; if of iron, generally black. Artificial and inartistic in the extreme are the churchyards bristling with these same iron crosses, the whole rendered the less inviting by the hideous array of mauve and white bead basket-like "immortels." Sometimes amid the withered remains of wreath and chaplet one sees enclosed within a glazed box or bell-jar a faded photograph of the deceased; at other times, affixed to the crosses are miniatures—attempts at likenesses—usually very rudely executed.

Cold and repellent, to our mind, are Swiss churchyards, the heterogeneous tributes disfiguring. Untidy and devoid of growing flowers, one would think the Switzer deemed it vain to try to grow them there—an opinion held by the writer of the old English verse:

"Strew upon my dismal grave
Such offerings as you have—
Forsaken cypresse and yewe;
For kinder flowers can take no birth
Or growth from such unhappy earth."

In connection with interment, the practical, as opposed to the sentimental, side of the Swiss character comes out strongly. For the bones of those thus reverentially consigned to the mother earth are not allowed to rest there in peace indefinitely; the Switzer considers his land too valuable to be

SWISS CATTLE

o'erspread to any extent with the remains of his forefathers. He therefore, after the lapse of a certain time—never in any case exceeding thirty years—digs up the bones and stacks them in bins around his subterranean—and sometimes above-ground—chapels and churches. A grim sight indeed it is, whilst attending service in such an underground chapel, to see around the living the bones of hundreds of those who have passed away ranged tier upon tier in open bins around the walls, their skulls grinning out towards us whilst resting upon their thigh-bones.

A bright side to the Switzers' character is their uniform and absolute honesty, and this is observable in regard to their little farms and to the ownership of the produce of the fields. No man requires to put a hedge between his pasture and his neighbour's. The cattle seem almost to know the boundary, and the unlucky animal which may stray on to foreign land is promptly driven back by its own herd-tender. Similarly, though fruit hangs in abundance from the trees, and in tempting proximity to the passer-by, yet no one would raise a hand to pluck a single plum, or stop to pick up a fallen apple. Truly an example that, as we shall see elsewhere, might well be copied by their neighbours, the Italians.*

The real wealth of the Swiss farm lies, not in

* "A Glimpse of Fair Italia."

SWISS CATTLE

its dead stock, but in its cattle, sheep, and goats, though for each farm the number is very small, so that frequently the herds are not sufficient to warrant each having a separate tender or cattle-herd. In this case we find that one drover will be chosen for several farms, or even for a whole village; and this occasions one of the queerest sights to be witnessed in these sleepy little *dörfen*, for at night it is strange enough to see, from the herds of cattle as they are driven back to their homestead, each individual member suddenly leaving the rest in the village street, and shambling—irrespective of the destination of the others—into her own stable beneath



XXIV.

the timber veranda, on which stands the *frau*, casting an inquiring eye upon "Liza," and thinking of her health, as she carries her tinkling bell—with which she will arouse the household betimes in the morning—into the door below.

It is evening, and we are pleasantly disturbed by the sound of quite an orchestra of bell-music approaching, and we must stand aside for a round

CURIOUS COWS

dozen of sleek, well-groomed, well-looking cows, each with a broad leathern collar round her neck, from which depends an ever-tintinnabulating Alpine cowbell. The tinkle of these is pleasant enough when heard far up the mountain-sides as their bearers move slowly about their pastures, but when met by a perfect regiment one feels relieved that they are of wrought metal riveted up, and consequently not in the least sonorous. It is the month of October, and the slowly-walking, serious-visaged old dames are coming down from their elevated grazing-grounds, not to return again until winter's snows are giving place to the fresh green of the erstwhile hibernating turf.

For the benefit of lady cyclists we will here say a word, and beg them not in the least to mistrust or fear these sober beasts—they are as harmless as children, and even more inquisitive. The latter attribute may, however, constitute a danger, for in passing through a drove of them they will often put their heads in front of the machine, not offensively, but in order to scrutinize it. This peculiarity of theirs we had to learn by experience. Meeting a large drove in the Rhone Valley, we gave place to one side of the road, only to be followed by a fine old cow, evidently bent on research. We knew it not, however, at the time, and having been driven close up to the door of a Swiss chalet, we dismounted with more expedition than grace, whereupon we

"LIZA" THE COW

heard a hearty guffaw from above, and, glancing up, saw an old Swiss peasant resting with her elbows on the balustrading of her veranda. "Ah, monsieur," said she, "the old cow is but too curious." Thus reassured, we let the "old cow" have her way, which was to carefully inspect the mount, and then to start vigorously licking at the front tyre, doubtless hoping to find it salt.

In this relation it may be mentioned that it is a common sight to see cattle, sheep, and goats, in passing through a village, vigorously scraping away with their teeth and licking the stucco of the buildings for the little salt it contains. Indeed, we were informed that so keen is both their desire and their scent for it that they would follow the possessor of a pocketful of it any distance. Who is there who cannot at once detect *pré salé* from *mouton ordinaire*? And do we not see on the more *recherché* of Parisian *boucheries* the announcement, *Véritable prés salées*?



xxv.

We said "well-groomed" advisedly, for it is a common thing to see a cow-waitress, as we may call the patient and industrious cow-herding woman, brushing away at the shining coat of her solitary charge, whilst the latter peacefully nibbles at the thick grass. Because they are never left alone, the

THE COWHERD

cows become like children. There being no hedges, they are never allowed out of sight of their watchful attendant. The maid-in-waiting stands about the little apology for a meadow industriously knitting away at her stockings, and apparently doing anything but looking about her ; but should one of her charges essay to cross the—to ordinary eyes—invisible frontier to some other “ Tom Tiddler’s ground,” she is sharply called to book with a “ Hé la, Liza !” for not only cows, but even lambs and goats, have their names. It is often amusing enough to watch the behaviour of “ Liza,” who pretends not to hear ; but let Grisette advance but a few paces, stick in hand, towards the frontier, and in the most unconcerned manner, and as if a wandering thought never entered her great head, she slyly sidles back upon her own domain. Having learnt some of their idiosyncrasies—one of which is that they like their noses rubbed—we often afterwards saved ourselves the trouble of dismounting by gently pushing aside the great hairy muzzles of the “ too curious.”

The last old cow is shambling past us, and the rear is brought up by a peasant, but of the female persuasion. There she comes, alpenstock in hand, a handsome brunette, her shoulders enveloped in a shawl of rather vivid red plaid. She is clean and neat, and her raven locks peep out from beneath a *kappe* of snow-white linen, reminding us very much

SUMMER AND WINTER

of the good housewives to be met with near Haarlem or Utrecht. Passing us, she drops a respectful curtsy, comments on the bright day, and says "it is good for the *velo*."

To our mind, the domestication of cattle and sheep is very pleasing and as it should be. Does not that student of animal and insect life, Sir John Lubbock,*

say: "When we consider how much we owe to the dog, man's faithful friend, to the noble horse, the patient ox, the cow, and the sheep, we cannot be too grateful to them. If we



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cannot, like some ancient nations, actually worship them, we have perhaps fallen into the other extreme, under-rate the sacredness of animal life, and treat them too much as *mere machines*."

Not alone the animals, but the toilers who work with them—are not we apt to look upon them also as mere machines, and to dub their occupation

* Now Lord Avebury.

THE WINTER HOME-COMING

debased, forgetting that almost everything, as Hamilton says, "that the peasant does is lifted above vulgarity by ancient and often sacred associations"? We should also bear in mind that the Swiss peasant is quite a different kind of person to our own agricultural labourer, for they are all masters or part-masters.

It is pleasant enough here in summer, as the tourist roams from village to village noting the industrious Switzer at work in the fields, but what a different aspect the mountainous land presents in winter! True, the scenes are beauteous indeed—these Alpine landscapes painted in virgin whiteness, the leafless trees like phantoms hung with hoary frost and snow—when

" Winter is here, and the feathery flakes
Are falling so softly side by side,
Weaving a vesture new which makes
This ancient earth like a youthful bride."*

Therein is delight for the eye of the stranger; but what of the Switzer? For the peasant it wears a very different aspect; for him it means keeping his cattle within their sheds, and himself within his house, for long months without a break. It means the consumption of hay, so laboriously gathered, the burning up of his little store of wood in order to get warmth. It means for the *sennerin* the

* B. L. Tollemache.

THE WINTER HOME-COMING

evacuation of her high-poised *hutte*, her descent to the valleys and villages, to the gratification doubtless of many a bourglet swain, who might well cry to her with Tennyson :

“Come down, O maid, from yonder mountain height :
What pleasure lives in height—
In height and cold, the splendour of the hills?
But cease to move so near the heavens, and cease
To glide a sunbeam by the blasted pine,
To sit a star upon the sparkling spire ;
And come, for love is of the valley—come,
For love is of the valley—come thou down
And find *him* by the happy threshold.”

But the Switzer, unlike his Italian prototype, does not hie him below to his cattle-stall, and shiver and sleep away his winter in idleness and filth ; he betakes himself to some other occupation, and so earns a little more to help keep the wolf from the door. There in the warmth of his *châlet*, by his own fireside, and mid the comforts of his family, the Switzer works on, nor is he unmindful of others less happily circumstanced. To them he will lend a helping hand, offering the shelter of his *châlet* and a bite and sup with his household.



XXVII.

THE SWISS VILLAGE INN

“Three stealthy winter months of frost and storm
Have piled this mountain-pass from peak to peak
With trackless avalanche and snow-wreaths bleak,
Obliterating road marks, blurring form.
One thing alone upon the waste is warm :
One low-roofed house, where struggling men may seek
Shelter, when whirled tornadoes round them shriek.”*

From these long winters may be traced the introduction of the home employments. Swiss manufactures, be they lace, embroidery, silk and cotton spinning, watches, jewellery, or wood-carving, all exhibit honest workmanship, and are all world-renowned. Different districts have recourse to different occupations, but in all one or more of these winter trades is carried on.

Even in the Switzer's village inn there is far more of homely comfort than is to be found elsewhere in a hostelry. We dismount after a long day and enter the quaint, picturesque, timber-fronted one there by the noisy river's side, at the sign of the *Drei Könige*.† The parlour, though innocent of carpet, with sanded floor, and all timber, reminding us of Guttenenn, is cosiness itself after the icy fog of evening we have just run through. In the corner is the inevitable tiled *calorifère*, but it is an exceptionally low one, so that some of the villagers rest their arms upon it, whilst others turn their backs to it and lean against the warm tiles as

* John Addington Symonds.

† At Andermatt.

THE SWISS VILLAGE INN

they discuss what pleases them—generally village topics.

Alas! things in these Swiss valleys and inns are changing. Even conversation in a far-away Alpine inn has undergone a sweeping change in the course of the last half-century. Five decades past the conversation was wholly village *causerie*, except when news arrived, and this by word of mouth, of the happenings in neighbouring cantons, to be heard from the *cocher* or “guard” of the “diligence” as it drew up at the sign of the Three Kings, and the weather-beaten driver, with a genuine sigh of relief, threw down his ribbons—of rope—on to the backs of his steaming horses and descended to the cosy parlour for the night.

One of mine host's sons had spent much time valeting in England, and had done some “couriering in foreign parts,” so that he spoke English well, and his conversation was very interesting. The figures he gave of the numbers of horses kept by mine host for “diligence” service and for waggon transport haulage would never have been guessed, so large were they. Almost night and day and summer and winter these convoys of travellers and merchandise were merrily bowling or lumberingly creaking over these mountain pass *routes*. Now accounts of incidents happening the world over are quickly speeding on invisible wings and the network of wires and cables in which its sphere is enveloped. These

VILLAGE CAUSERIE

are translated into many tongues, and in due course—it may be days, it may be weeks—they arrive in the recesses between the towering Alps. If we remember rightly, the discussion of the evening was an unusually animated one, for news had arrived of a gigantic conflagration in London.* The figures approximating to the losses involved, when converted into francs and marks, simply baffled the *Thal* dwellers' comprehension, and gave rise to many and many a loudly-expressed "Got! ah, Got!"

Although we are quite sure the honest villagers could not conjure up the slightest veritable approach to the *appearance* and *magnitude* of our gigantic warehouses, which seem to have such a predilection for sacrificing their walls and the immense treasures therein contained to the all-destroying flames, yet they were able to draw analogies between the numbers demolished and the numbers contained in villages within their own cognizance. Fires, too, they unfortunately were well acquainted with, and they told of the total destruction of this and that town and hamlet. But what did the whole number of cottages—and the church—amount to in comparison with this great town just laid in ruins, this small patch of crowded commercial London? They could scarce "stomach" it, and several venerable heads shook dubiously, and others sadly, at the thought that it would take quite a century for

* The great Wood Street fire.

THE VANISHING DILIGENCE

London to recuperate from, and rise *Phoenix*-like from, the ashes of this terrible "devastation." Had it been in their own valleys, they would have said "awful visitation."

No, the gay uniformed and booted *conducteurs* no longer sit around the bare-floored parlour in their numbers, the pack-horse drivers no longer stretch their weary limbs out in the hayloft in their dozens. Man's mental power has combined with his physical strength and daring to alter all this. He no longer toils up the mountain-pass beside his blowing pack-horse, for he, mole-like, burrows through the hardest rock and beneath the giant mountain. The slowly-trudging, patient, willing motive-engines of Nature, with distended nostrils and strained flanks, dragging his *quota* of the slowly-moving load up the mountain's brow, he replaces by his wondrous metallic steeds, ponderous and fleet, which with painless exertion roar and pant, as they draw their vast burthens over the iron roads and through the rocky borings he has made.



XXVIII.

But the evening, in company with the Switzer *auberge habitués*, has pleasantly passed, for all retire *de bonheur*, and, we believe, *en bonheur*. This was certainly so with us, as our obsequious host conducted us to our scrupulously clean and snowy-lined *bett-kammer*, for the keen Alpine air is extraordinarily

SWISS EMIGRATION

efficacious in bringing the "dustman" to one's eyes.

Here in the village inn, as in the châteaux of the Switzer, the contentment and sobriety observable are largely attributable to the good influence of education.

The Switzer's affection for his native land, to which we have referred, also plays a most important part in this much-to-be-desired spirit of contentment.

"For every good his native wilds impart
Imprints the patriot passion on his heart ;
And e'en those hills that round his mansion rise
Enhance the bliss his scanty fund supplies.
Dear is that shed to which his soul conforms,
And dear that hill which lifts him to the storms ;
And as a child, when scaring sounds molest,
Clings close and closer to the mother's breast,
So the loud torrent and the whirlwind's roar
But bind him to his native mountains more."*

The difficulty of working out a bare subsistence from his beloved soil, however, frequently necessitates his journeying to foreign lands—usually our own—in search of employment and a competency, but he leaves with the full determination to return, and to bring back to the land of his birth the fruits of his toil.

Usually he sets out with a little party of his compatriots, all bent upon the same errand, and on

* Oliver Goldsmith.

THE SWITZER'S LONGING

several occasions we have been eye-witness of scenes at once pleasurable and distressing—of the leave-takings of a band of Switzer lads from their aged parents, their sisters, brothers, and lasses. This sojourning abroad and subsequent return to their native valleys is especially the rule with the Engadiners, who are forced to its adoption by the great length of their winters—nine months of winter and three months of cold weather, as their seasons have been facetiously referred to.

These lads usually begin life as hawkers or waiters, and, in regard to the latter, we may point out that it is a common error to suppose that the overwhelming influx of *restaurateurs* as well as of waiters—which is discreditable to the enterprise of our own nation—is due to the Italians, an error naturally made through the Italian *genre* of name borne by the immigrants, and by the assumption that their language is that of Italia; whereas, in fact, these men are temporary sojourners from the cold and lovely Engadine, their language Romansch. We can well conceive these industrious fellows, pushing the humble barrow of the hawker, sleeping in the close attic of the nought-paid waiter, or at work in the hot *cuisine*, feeling the period of their enforced absence long indeed, and sighing :

“ Oh, when shall I visit the land of my birth,
The loveliest land on the face of the earth ?

TYPES OF SWITZERS

When shall I those scenes of affection explore,
Our forests, our fountains,
Our hamlets, our mountains,
With the pride of our mountains, the maid I adore ?
When shall I return to that lowly retreat,
Where all my fond objects of tenderness meet—
The lambs and the heifers that follow my call,
My father, my mother,
My sister, my brother,
And dear Isabella, the joy of them all !
Oh, when shall I visit the land of my birth ?
'Tis the loveliest land on the face of the earth !”*

In such a diverse land the inhabitants differ materially in type of face and build of body. On the Italian borders they are all dark, and these Engadiners, often of fine build, speaking *Romansch*, are the handsomest of the Switzers. The face of these is of the ovoid type. The French-speaking population, such as the Genevese and dwellers in the lower Rhone Valley, are shorter, round-faced, square-shouldered, and about equally balanced in regard to complexion, dark perhaps preponderating ; whilst the people of the German-speaking cantons—the Lucerners, the Zurichers, and the dwellers on the skirt of Switzerland northwards—are tall, fair, with longer faces and higher cheek-bones. They are “striders”—men who appear to be moving at no speed ; but walk with one, and you must needs “hurry your stumps,” and may well feel that

* James Montgomery.

SWISS BURTHEN-CARRYING

“Right up Ben Ledi could he press,
And not a sob his toil confess.”

The modes of life of the three races as regards the towns vary widely. Take, for example, their custom in drinking. The first-mentioned drink wholly wine—excellent red wine ; the second, beer and wine about equally, with a preference, in regard to the latter, for white rather than red ; the last, lager-beer exclusively.

In several of the cantons that terribly disfiguring disease *goitre* is prevalent, the cause of which is not at all accurately known, though variously ascribed. It is a hideous enlargement at the side of the neck, and is said by some to arise from drinking the waters of certain mountain streams, while others ascribe it to the prevalent custom of carrying huge weights upon the head.

Whether this be so or not we are unable to say, but often have we been struck by the enormous weights carried by both Switzer men and Italian women. One of the most extraordinary sights—and at the same time the most degrading to the men—is to see the Italian women at Sorrento and other Southern ports carrying huge “Saratoga” trunks—which ought never to have been taken there—upon their heads, and this up long flights of stone steps. The Tyrolese system of burthen-carrying by straps from the shoulders is at once more rational and humane.

SWISS PATRIOTISM

The Swiss are essentially honest. They are sticklers in little matters, but for uprightness and trustworthiness probably surpass any other Continental people. They are almost to a man industrious, and hence very early risers. Up with the sun and to bed with it in summer, and even in winter, scarcely expresses their workaday hours, for we have often been up to see the sun rise, and seen them there in the gloom of morning at work. Indeed, they are about long before one would think it necessary, for even the busy bees in their hives at the centre of the workers' little plots must at times feel shamefaced. The bee works but in sunshine and summer; they toil midst sun and shower, heat and cold, summer and winter. Simplicity is a characteristic of their habits, many of their old-fashioned methods dying hard among them.

A very potent trait in their character is patriotism and affection for their native soil.

" 'Tis mid these regions of stern hill and flood
That Freedom loves to nurse her darling sons;
Few are their number, but their virtue runs
And circulates and mixes with their blood:
'Tis this unflinching valour, which lath stood
Before the o'erwhelming host, which awes and stems
The lowland son of ease, who, shrinking, shuns
The unequal contest. Firm as storm-tossed wood,
The eyrie-cradled 'Switzer' laughs to scorn
Him who could live a slave, or fear to die

SWISS PATRIOTISM

For what is dear—more dear than oil or corn
Or boundless wealth—highly-prized liberty.
The blazing deeds which History's page adorn
Even now have living power in Europe's eyes.”*

No matter where they roam or how much they acquire, back to their native valley they will sooner or later return. They are ever ready now as in the past to defend their hearths and homes and to keep the country inviolable from the invader. Perhaps it is this patriotism which makes them a shade inhospitable to strangers whilst sociable enough amongst themselves.



XXIX.

The foreigner is welcome enough, however, while he pays, but woe to the unlucky wight who could not pay! His lot would fall amongst few Samaritans in Switzerland.

The Swiss are ever content with small families; two or three children are, indeed, an excellent sufficiency for their comfort. Theirs a country without colonies, they are wise, and there are

* F. A. Mackay.

DEFENCE, NOT DEFIANCE

many other nations would do well to copy their example.

The men are tough and hardy enough. Wiry and muscular, they have ever been renowned as soldiers and riflemen, and, judging by the excellence of their shooting, they would to-day be formidable enough. Every man has to serve in a sort of local militia, and his gun, sword, and uniform ever hang ready to be donned if occasion call.

Upon this subject Mons. Birmann, President of the Senate, recently uttered the following patriotic and forcible words: "Happy the people who husband their strength in order to employ it in case of need against an external foe. They deserve to remain an independent nation. But doubly happy the man who loves his homestead, who is deeply affected when he sees the soil of even a small part of his country destroyed before his eyes.* He thereby proves his love for his fatherland, for the common home. We have not to deal with figures, but with the mightier forces of the emotions. It is a question of preserving the land of our fathers. The soil of Switzerland shall be diminished neither by an external foe nor by the terrors of Nature. The inner work of a nation is recognised in history not only by the heroism displayed on the battlefield, but also in the works of peace it has created."

* He was speaking of the devastation wrought by the Mörjensee.

THE MÖRJELENSÉE

Needless to say that, in the simple minds of the mountaineers, anything which to them may appear an aberration of Nature's routine work, especially if it act detrimentally upon their own, is at once attributed to supernatural agency, and superstitious invention then runs riot.

The extremely interesting phenomenon connected with the enormous *Aletsch* glacier, to which Mons. Birmann referred, and to which we also refer else-



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where,* has given rise to a fanciful myth. High up on the giant glacier, 7,000 feet above sea-level, entrapped, as it were, in its vast mass, is a lake, the *Mörjelensee*. Dwellers in the Oberaar know full well that this lake periodically empties itself—a phenomenon which may well strike awe into their souls. Every seven years, say they, its enormous

* See Chapter IV., "Dame Nature's Masons."

SWISS LOVE OF MOUNTAINS

volume rushes through the fissures and crevasses of the glacier, creating such terrific crackings, crashings, and snappings of *seracs* and roarings within the icy vaults as one cannot even imagine ; and then all is silence : a few pools of water in the hollows of the sandy valley bottom are all that remain to tell the tale of the angry outburst.

To this natural occurrence the peasants attach the fanciful legend that a terrible and powerful magician, one *Rollibock*, bursts at times with fearful uproar from the Aletsch to destroy the rash wights who venture to provoke or mock him. The swiftest cannot escape him, and those he seizes he grinds to powder. He is said to assume the shape of a he-goat with long horns and fiery eyes, while instead of hair his entire body is covered with icicles, which latter make a terrific clatter as he rushes at full speed upon his foes.

Surely, when a known fact and a terrifying suspense hang over the simple mountain-dweller, such myths may be forgiven. Quite without cause, though, may they frequently be found, and they are oftentimes as pretty as they are simple.

The Swiss are close-fisted when alive, but should they die possessed of anything approaching affluence, they usually make up in their wills for their parsimony during life.

A trait gratifying and pleasant to observe in the Switzer's character is his unaffected and sincere love

AN AUSFLUG

of his own *lieber* native mountains. "Familiarity breeds contempt," runs the adage, and true enough! Happily, it does not hold good in regard to the estimation the Swiss have of the beauties of their country.

Long before their holidays come round they subscribe and band themselves together for a happy pedestrian tour among their mountains. Such expeditions are properly and most carefully plotted out and arranged for, and their journeyings include such distances for the diurnal goings of these lowland mountaineers as would simply appal the Lancashire mill-hand, the Staffordshire smith, or the London clerk. Unhappily, the demonstrations of happiness (*sic*) of English bean-feasters—usually a maudlin hilarity—is as offensive to others as it is inefficient to themselves. The Switzer tripper's pleasure gives pleasure to others, for it takes the form of singing—trained and very creditably executed.

At the *Weisses Kreuz** in ancient Thusis we had the pleasurable advantage of coming upon such an *Ausflug*. No less than forty sat down to mid-day dinner—a right merry dinner with much toasting, but no vulgarity. Of the contented forty no less than thirty took part in glee-singing. The repast over, this array of stalwart mankind formed up in a semicircle, whereupon a tall and upright, long-necked, closely-cropped figure—they all crop close before start-

* White Cross Inn.

AUSFLUG v. BEANFEAST

ing on an excursion—stepped forward as conductor. His deeply bronzed face and horny hands peeped out incongruously from a “Sunday” suit of neat blue serge as he stood before his thirty, conducting with nothing more obtrusive than a short pencil. A few held books or paper score, but he eschewed both and himself sang as lustily as the rest.

The type of song rendered revealed the sentiment of the singers. They sang of their “beautiful Switzerland — their home”; and when, in canon, the stentorian basses melodiously asked: “Will you mount with us to the high peaks of our Alps?” conductor and tenors gleefully rejoined, “Willingly, willingly will we go.” A pretty madrigal, “The Old Sweet Dream,” which was about the tranquil mountain home and the staunch Frieda waiting there, gave an opportunity for that fine Alpine diminuendo effect in which the splendidly deep bass is the last voice to die away, leaving that spell of insatiated pleasure to the listener which can be produced by the long-necked, deep-set-larynxed Switzers and Tyrolers alone.

“Stalwart, stout-hearted *Swiss*, of that staunch race
Who kiss the hands of Danger in their youth,
And swear him loyal service; oft they die,
Slain by these ruffian crags, yet all the more
They bless and love them, counting time and life,
Beyond their shadow, grief and banishment.”*

* Starr H. Nichols.

SWISS SINGING

Would that our workers cultivated voice and song and pleasure in the singing! Imagine forty British workmen rising from *their* bean-feast and their pewters of "four-half" to sing a glee or madrigal, correctly and with feeling, enjoying and imparting enjoyment to others, elevating others, refining themselves. Those who may have "assisted" at such annual functions will, we fear, say they *cannot* imagine it.

Dinner, dessert, and concert discussed, we observed the jolly Switzers divesting themselves of their collars and cravats—Swiss *ouvriers* wear such things—and replacing them by silk kerchiefs, neat and clean. What could this mean—fisticuffs or skittles? Collars, cuffs, and cravats were wrapped in paper, and we watched to see where they were to be stowed. Following a lithesome Switzer into an adjoining room, we found ranged along the walls forty serviceable goatskin knapsacks, in which these concessions to etiquette were safely deposited ere the vocal pedestrians strapped knapsack on back, glad to be rid of such restraining apparel as they trooped down the staircase *en route* to Andeer for tea and Splügen for the night, to be followed by a glorious tramp over the Alps by the Bernardino, and back by the St. Bernard to Basle. They flaunted no garish banderoles, they flourished no brazen trumpets, yet they swung along to an inspiring march from their own conveniently portable

PESTALOZZI

instruments. A few minutes later, Gretchen, richer by several francs, might have been seen wending her way to the post-office with over a hundred of those pretty souvenir post-cards going in advance to their homes to tell of their happy visit.

Having witnessed such a pleasant entertainment and admired the uniform good behaviour of the participants, we must needs ask ourselves, What may have led to it? To which we may also unhesitatingly reply, Education.



XXXI

The Swiss have indeed been wise in their generation in the matter of education; they strive by a well-bestowed liberality so to instruct and fit their rising generation that they, at least, may be in the most favourable condition to breast the stream, to rise up boldly like their own mountains, instead of drifting downwards to the ocean of despair. "Most of our children," said a Swiss statesman, "are born to poverty, but we take care that they shall not grow up to ignorance." So that it cannot be said of the populace :

SWISS EDUCATION

“Knowledge to their eyes her ample page,
Rich with the spoils of time, did ne’er unroll ;
Chill penury repressed their noble rage,
And froze the genial current of the soul.”

Switzerland is justly proud of her educational system, and seeing the mountainous nature of the country, the sameness, as one might assume at first sight, of occupation it offers, the difficulty of school attendance, and other characteristics, one is the more anxious to belaud the Switzers’ prescience.

This they owe to the intuition of a born educational reformer, one Johann Heinrich Pestalozzi, who in unenlightened years laboured among them, showing them how children ought to be educated, not taught, the dreary drudgery of his own school-life having urged him on to brighten the lives of his successors. His theories, coming at the time when Europe was ripe for innovations in this direction, soon attracted general notice, and many were the teachers who went to study his method at the school he had founded by dint of the most laudable efforts and perseverance.

As we pedal through the interesting townlet of Yverdon, we should not fail to dismount and look up in admiration to this father of the school—the devoted Pestalozzi, standing there in benevolent attitude characteristic of him between two of his dearly-loved waif pupils ; for he argued that the teacher must be at once guardian, friend, guide, and

SWISS EDUCATION

playmate, imbued with the everlasting spirit of youth, guiding the footsteps of the young to the acquirement of knowledge, not merely acting as the force-pump of book knowledge.

He was born at Zurich in 1745. A man of action, of earnest endeavour, and, above all, of unswerving sincerity of purpose, he yet seems to have lacked that attribute, tact, which goes so far to discount the success of many of the ablest and most energetic of workers, for he failed in many of his essays. Nevertheless, he initiated, with a devotion worthy of the highest praise, a system of education of which our present is but a modification, and so his good work has succeeded after him in a degree out-balancing a hundredfold his personal failures.

He is described as having been eccentric, quixotic, and from his youth eager to be an adjuster of social wrongs, which after various abortive means he attempted through the education of the young. Before his time the world had numbered among its great men many *savants*, many philosophers, many scholars, but these men were more in the nature of students themselves than teachers. It is true that others learnt by their written works, but such others were themselves, perforce, educated far above the average, so that these men of light and leading, if they might be spoken of as teachers, certainly could not be as schoolmasters. They established the high position the study of the classics assumed and has

SWISS EDUCATION

continued to hold. Pestalozzi, on the other hand, devoted himself to education, to direction, and to personal teaching, and from his day forward two ideas of education have co-existed—the one, the older, applicable to the children of the classes; the other—his—appealing to and touching the masses.

Pestalozzi lived during the time of the French Revolution and the wars of Napoleon, finding in those times of strife and in his disturbed country, amid war-inflicted misery, adequate opportunity for the display of that self-sacrifice, that devotion to the oppressed, and that sincere and unselfish love of the children of the poor by which he was specially characterized.

His father had died when he was very young, and his mother had brought him up. His earliest years were spent in the formation of schemes for ameliorating the condition of his fellow-people and compatriots, his acquaintance with Blumtschi giving to such endeavours a political bias; but the death of his friend caused him to devote himself more especially to education. At twenty-three years of age he married, and purchased a piece of waste land. Thereon was a farmhouse, and he essayed the cultivation of madder. This was the farmstead of Neuhof in Canton Aargau. Justly believing in the moralizing virtue of agricultural occupations and in the elevating influence of rural environment, he at once embarked upon his educational scheme, choosing

JOHANN HEINRICH PESTALOZZI

this farm as an apposite *locale* whereon to dwell with his collected waifs and strays as a father among his own children.

Here, with absolute self-abnegation, he dwelt with his pupils, played, suffered, starved with them. He observed the expansion of their minds, he saw and felt his softening influence upon their hearts, a sympathetic affection serving to reveal to him every idiosyncrasy, every intrinsic trait, every characteristic hue in the individual *genre* of their dispositions.

Alas ! monetary difficulties arose, for Pestalozzi knew naught of business ; moreover, he was engrossingly engaged with his loved charges. " I was," he says, " from morning till evening almost alone in their midst. Everything which was done for their body or soul proceeded from my hand ; every assistance, every help in time of need, every teaching which they received, came immediately from me. My hand lay in their hand, my eye rested upon their eye, my tears flowed with theirs, and my laughter accompanied theirs. They were out of the world, they were out of Stanz, they were with me and I was with them. Their soup was mine, their drink was mine ; I had nothing. I had no house-keeper, no friend, no servants around me ; I had them alone. Were they well, I stood in their midst ; were they ill, I was at their side. I slept in the midst of them, the last who went to bed, the first who rose in the morning. Even in bed I prayed

HIS POVERTY

and talked with them until they were asleep. They wished it to be so."

His agricultural operations failing, and the house being required in 1799 by the French as a hospital, the children were dispersed. He then went to take up a subordinate position in the people's school at Berthond (Burghof). Here he was shortly thrown out of his employment by the bigoted, conservative, and jealous senior master, to find himself penniless at the age of five-and-fifty. Then did he experience the bitterest pangs of poverty—so keen, indeed, that he had even to keep away from church for the want of suitable clothing. Nevertheless, he succeeded, under



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the patronage of the Swiss Government and in partnership with others, in setting up an experimental school in the same village. Whilst there he published "*How Gertrude educates her Children*," a work which was read with avidity, especially in Germany. It contained an exposition of the Pestalozzian method, which consists, among other things, in proceeding from the easier to the more difficult, beginning by observation, to pass from observation

THE PESTALOZZIAN METHOD

to consciousness, from consciousness to speech, then to approach to measuring, drawing, writing, numbers, and so on to reckoning and deduction. The soundest of all theories or methods must be that based upon the observation of Nature. He set forth that the development of human nature should be



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made dependent upon natural laws, that in order to develop a rational method of teaching one should learn first to understand Nature, its processes in man generally, and in individuals particularly; that this should be carried out by observation on the part of the teachers and then taught, such observation resulting in an intuitive perception of things, the method the best calculated to bring home facts to the understanding in the most durable manner. This intuitional education, as it has been called, represented the corner-stone of the

German folk-school (*Volkschule*) system, and provided the guiding principle upon which numberless books for children have been written, as well as the subject-matter for innumerable treatises upon education.

Although unable to cope with the world, Pestalozzi possessed an indomitable devotion, and his character was instinct with a loving sensibility and

AT YVERDUN

sympathy. He awoke men to a sense of their responsibility in the care and education of their offspring, and is said to have "ushered the nineteenth century upon the stage of history as the educational age *par excellence*." He came after Rousseau, whose views, enunciated in "Émile,"* upon the care of children and upon their education forcibly impressed him.

He is said to have been illiterate, ill-dressed, a bad speaker, and a bad manager, yet we find him in 1802 deputed to Paris and doing his best to interest Napoleon in a scheme of national education. The education of the masses, however, presented to the mind's eye of the great tactician visions the reverse of pleasant, so he said "he couldn't trouble himself about the alphabet."

In 1805 Pestalozzi moved his school to Yverdun, and for twenty years worked doggedly at his self-imposed task. Here he was visited by all who took interest in education, among them Talleyrand, Capo d'Istria, and Madame de Staël. He was lauded by Von Humboldt and by Fichte, and many of his pupils subsequently became notable men.

At Yverdun, however, he seems to have made a mistake fatal to his success. The eyes of all Europe had been drawn to his school, and in the moment of his greatest success and popularity he is said to have entered upon a course of mistakes, leading him

* See "Fragments from Continental Journeys."

DEATH OF PESTALOZZI

ultimately to his grave, a disappointed, an unsuccessful, and a sorrowful man. Deviating from the field of primary teaching in which he had previously occupied himself, he applied his method in a large secondary school, to which were attracted the sons of notable Europeans by reason of Pestalozzi's fame. Then his old incapacity in the management of practical affairs began to assert itself. About 1815 dissensions broke out among the teachers, with the result that his last ten years of life were chequered by anxieties, overshadowed by weariness and sorrow. Step by step the school declined, until, in 1825, it was finally closed. Then it was that Pestalozzi, distracted by the enmity of some of his former colleagues, and under the weight of eighty years, sought retirement to the home of his youth, Neuhof, there to write the story of his life, and then, sinking under difficulties of his own involuntary making, an object of mingled pity and respect, to address to mankind his last prayer for education, the "Song of the Swan," before passing away from this tumultuous schoolhouse of Nature, February 17, 1827. Yet, as he himself said, the real work and effect of his life "lyeth not merely in Burgdorf."

We have only to pause before one of those rural seminaries we meet with in or near every Swiss townlet to see, or hear, the good work going on. They are picturesque little *bâtiments*, Swiss *châlets* on a somewhat larger scale. Walking early one

A SWISS "DOTHEBOYS HALL"

morning, we came upon a typical *schulehaus** perched high up above the valley, built entirely of timber, looking very neat and trim, with its big, sheltering roof, its timber sides appropriately frescoed with moral mottoes. It was early—indeed, the sun had scarcely reached us yet. Through the woods, unseen, ran little Alpine boys on their way to school, *jodling* to other little fellows, equally unseen, upon the other side of the valley, the echoes as well as their companions answering them.

The sun is there before us, though, lighting the room, if not lightening the task of the youngsters. They themselves are in gloom because they are there forced to imbibe that which is the veritable "milk of human kindness," yet their little minds know it not. "Learning," said Fuller, "is the greatest alms that can be given," whilst we know that *Pouvoir sans savoir est fort dangereux*. Oh that we *could* put old heads on young shoulders! At this moment it seems they are tolerably happy, especially the girls, who are invisible because upstairs, for all are singing. The boys, too, are jumpily singing "responses."

Yet how quickly does the little black cloud of trouble appear in the clear sky of happiness—as quickly in the schoolroom, indeed, as in the school of life! Quietly we went up the few steps and peeped into the Alpine "Dotheboys Hall." Perched

* Above Grindelwald.

THE SCHULEHAUS

up at the back of a small pulpit-like desk was a big, fair old fellow with a broad-browed bald pate. The monotonous hum of his gentle diction stopped suddenly—there was a flash in his eye and a twig in his hand; we saw him lean forward, we heard a swish, and then a rippling titter. We could not see what had happened, yet we knew what the dominie wanted had *not*. The hit was a miss—Irish, but true. Happy youngster!—no, *unhappy* youngster. He—bald pate—is coming down from the pulpit; now we can see neither him nor little him, but we hear long and heavy strides—*whack! whack! whack!* Long and heavy strides: there's his shiny pate again, the pulpit knows him once more, and a part now knows discomfort other than that of the cold morning.

So, with alternations of feelings—joy and sorrow, grins and grimaces, pleasant quippings discharged at one end, unpleasant whippings received at the other end, failure and success—the seminarial routine goes on, and not so *very* different from the mundane routine of post-school days. Now again they are singing and happy; but, still, it is a different kind of happiness, a different kind of singing from what we should hear were we to wait till they all came rushing out of school, as if from a long period of incarceration in *durance vile*. Out they will come like a pent-up flood broke loose—like a veritable avalanche, singing, shouting, shrieking;

LIFE'S STREAM

lungs, eyes, arms, all in vivacious developing action. Their lungs shout out the derisive nicknames of their companions; their eyes with electric rapidity spy them out; and their busy arms belabour less busy cropped, round bullet-heads with green baize school-bags and bullet-like books within them. The sunshine has long passed beyond the school-house, but there is still plenty of it bottled up in their merry little hearts. Down the timber staircase they come, with the impetuosity of buoyant childhood, like a cascade of tiny human units, chips off the maternal mountains, borne down on a soft bed of snow-like innocence.

So must they all rush down on Time's swift avalanche to the cold undeviatable stream of life. How many of them will breast it, stem it, make headway against it, and come out of it at its head—the summit of respect and success? How many will drift down it to strand, before they have gone too far, on an islet which will save them—on soil which will maintain them amid the vast population of mediocrities? How many of them, alas! will mistake life's stream for a stream of pleasure, and drift unconcernedly, swiftly down, until, when too late, they find themselves in the great, the pathless ocean of degradation and despair!

Here in the midst of these youngsters and speaking of the thoughtful and munificent provision made by the Swiss for their education, we are

EDUCATIONAL COURSE

tempted to compare it with our own and that of other countries.* But if we allow our thoughts to turn to such subjects—if we allow them to fly hundreds of miles away from here, as they are so apt to do, like faithful “homing pigeons”—we are guilty of disrespect to our noble companions watching at our side. We will, therefore, just say that at six years old schooling commences, and continues till the child is thirteen. This preliminary course all must go through. The necessary examination then passed, they are allowed—if they desire it—to continue through the secondary course until they arrive at sixteen; then, if they are able to matriculate, they have the right to go through the course at the University. Primary



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and secondary courses are free to all, irrespective of class, sex, or religion. Private schools may be had recourse to, but in that case the taxes apportioned to the keeping up of the Government educational institutions must be paid. The schools remain open about forty weeks in the year, and no excuse save a doctor's certificate is accepted for non-attendance.† The

* Education in Great Britain is the most expensive in the world. It costs annually £1 17s. per pupil. In France children are educated for 12s. a head yearly, while Switzerland only spends 10s.

† Heat holidays have been established by law in the elementary schools of Switzerland. Recognising the well-known

EDUCATIONAL COURSE

physically incapacitated, idiots, the dumb, the deaf, and children suffering from skin diseases, have separate establishments in towns, whilst in outlying districts they are exempted and not admitted.

The Swiss scholar has plenty of play. Gymnastics are freely indulged in, and drilling and marching form part of the secondary course of instruction; indeed, so carefully are matters planned, and so pleasant are things made, that we were assured that the children consider it the greatest hardship to be detained from school.

The teachers, too, are well and thoughtfully provided for by the Government. They are mostly women, are very well paid, and are never discharged, except for some serious cause. When they get so old that they cannot teach any more, they are pensioned liberally.* The result is that the country has an excellent corps of educators in the schools.

The result of this system is soon apparent in the happy, contented, well-educated people one sees throughout the land. They have been really "educated," therefore they know that by work and contentment comes happiness. To strive to attain

fact that the brain cannot work properly when the heat is excessive, the children are dismissed from their tasks whenever the thermometer goes above a certain point.

* Switzerland is the only European country which spends more than we do in relieving paupers. This calculation is per head of the population.

EDUCATIONAL COURSE

to the same position in which all one's fellow-men are living, and not to grasp after the shadows which can never become realities, is to bring the welfare of one's self and one's country to its acme. Some people have said that this education which is good for Switzerland would not suit our own land.



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This may well be, and this for the very self-evident reason that our petty class distinctions, due to the possession of a little more or less of this world's wealth, would not allow the system to fructify to anything like the best advantage.

There is little in this world which is not amenable to the potent sway of £ s. d., yet this might not appear to apply in regard to education. Nevertheless, statisticians have shown that money expended upon education is recouped in diminished expenditure upon the upkeep of our prisons. This has been very clearly put by Lord Avebury.

EDUCATIONAL COURSE

We trust that in these, the opening years of the twentieth century, they may be very few who have doubts concerning the immense moment of education—its social importance, its national value. Education is now so universally advocated, not only as being beneficial in making a workman a better man, but the man a better workman, that we should be glad to see some rational system of instruction—especially technical education—quickly brought to bear in regard to our younger people, that they might be the better able to live that life of industry and contentment, as well as to more successfully compete with the foreigner, which was so evident to us in Swiss ways during our Swiss days.



14



To face Chap. IV.



DAME NATURE'S MASONS.

CHAPTER IV

DAME NATURE'S MASONS

"There rolls the deep where grew the tree.
O Earth, what changes hast thou seen !
There where the long street roars, hath been
The stillness of the central sea.

The *hills* are *shadows*, and they flow
From *form* to *form*, and nothing stands ;
They melt like mist, the solid lands,
Like clouds they shape themselves and go."*

"As a man travels on in the journey of life, his objects of wonder daily diminish, and he is continually finding out some very simple cause for some great matter of marvel."



XXXVI.

in weight — poised on end by the side of the

"THE everlasting hills." Was there ever a more flagrant misnomer? We pedal along a valley bottom, and there close beside us is a huge rocky chip from off the mountain — hundreds of tons

* Tennyson.

CHIPS OFF THE MOUNTAINS

road. How did it get there? We have but to glance high up over our shoulder to see whence. Woe to him who shall find himself in the track of the next Titanic splinter which shall detach itself, and, with awful devastating energy, come to join its mates in the *thal*. But one scarce need prepare to dodge it in its course, for in the intermittences of shedding its scales a mountain thinks little of a few centuries more or less.

The gorge is fir-clad and narrow, and we commence to mount its side on a rapidly rising road cut in the solid rock. We soon find ourselves high above the roaring, tumbling torrent, its rocky bed here and there obstructed by a fine specimen of a fir-tree lying prone across it, oftentimes still grasping in its gnarled root-fingers the huge boulder which had nourished and supported it when proudly erect.

“Once in Time, and somewhere in the world,
I was a towering pine,
Rooted upon a cape that overhung
The entrance to a mountain gorge; whereon
The wintry shadow of a peak was flung,
Long after rise of sun.

“There did I clutch the granite with firm feet,
There shake my boughs above the roaring gulf,
When mountain whirlwinds through the pass did beat
And howled the mountain wolf.”

As we wind our way between mountain hips and shoulders, sometimes ankle deep in sand, some-

THE SOLEMN SOUNDING PINE

times blundering over rocky boulders, we shall grow accustomed to the "towering pine" and shall value its companionship, whilst the numerous instances of its destruction will serve as continual reminders of the change that is ceaselessly going on around us, and inspire us to inquire its cause.

"No longer Memory whispers whence arose
The doom that tore me from my place of
pride ;
Whether the storms that load the peak with
snows,
And start the mountain slide,
Let fall a fiery bolt to smite my top,
Upwrenched my roots, and o'er the pre-
cipice
Hurled me, a dangling wreck, ere long to
drop
Into the wild abyss."



XXXVII.

In order to view such change, to cursorily study and to appreciate the vast importance and effect of the labours of Dame Nature's masons in the past, and the arduous and aspect-changing nature of the work we may watch them day by day engaged upon, let us press up from the valley,* and threading our way through a pass,† scale a mountain ridge.

Rising by the characteristic zigzag, we find ourselves passing along the mountain-side at early

* At Meyringen.

† The Grimsel to Gletch.

NATURE'S CASTLES

morning, when the flat-bottomed valley is spread over with a pale-blue carpeting of mist, through which translucent veil we can just see submerged the tiny villages, their timber roofs, white walls, and tiny tin-covered spires; but ere long the giant walls of mountain commence to hem us in more narrowly.

Threading our way beneath pierced rocks, we follow the course of the gorge, now so sinuous that we cannot see far ahead; we dive into one of those rough-hewn tunnels which man has been forced to blast ere he could press onwards. O'er this glides a waterfall, hurrying to its annihilation in the turbulent seething below. Towering above the tunnel is an upstanding rock, strikingly resembling a grim castle gateway, surmounted by a huge tower holding watch like a sentinel to a Titanic castle keep, and from the roof of this, as in exultation, like feudal ensigns, spring two solitary stunted larches. Stern and defiant it looks to-day, yet if we regard it closely we see this castle of Nature is slowly but surely detaching itself from its parent rock. Noble and massy though it be, frost has signed its doom. Alas! future generations will see it but as *débris* mingled, unrecognisable, mid the million tons of splinter and scale composing the torrential bed.

Now the gorge seems closed to us, yet it is not, but merely tortured into brusque zigzag. Wherefore the cause? There it lies, a gigantic monolith

ALAS! ALL IS CHANGE

of still harder rock, prone across the foaming waters. Yes, by its vast mass and unyielding adamant it has resisted the sculptural skill of the impetuous and never-wearying graver. It has forced the sculptor to swerve from his purpose, and in anger he rushes straight for us, and then, as if he had again changed his mighty mind, he rushes back across the gorge, leaving bare the conquering rock across its path, still stemming its wild current like a great sea groin. Again, alas! bold as this huge monolith may be, proud of its victory over the almost resistless vehemence of the torrent, the wiseacres of its rocky sides, those sage heads, the venerable mountains rearing aloft, may well counsel it to moderate its exultation, for well they know its victory is but transitory. A few centuries hence the traveller—on an electrically propelled carriage, probably, will he be borne—if he see the bold rock at all, will see but an emaciated semblance of its former self.

“ From age to age, throughout the mountain bounds,
The crash of ruin fitfully resounds ;
Appalling havoc ! but serene his brow,
Where daylight lingers on perpetual snow.”

Alas! all is change. Speaking of such obstructions, Lubbock says : “ Sometimes the two sides of a valley are so near that there is not even room for the river and the road ; in that case Nature claims the supremacy, and the road has to be carried on a

"GREY PINES"

cutting, or perhaps in a tunnel through the rock. In other cases Nature is not at one with herself. In many cases the *débris* from the rocks above would reach right across the valley and dam up the stream. Then arises a struggle between rock and river, but the river is always victorious in the end; even



XXXVIII.

if dammed back for a while, it concentrates its forces, rises up the rampart of rock, rushes over triumphantly, resumes its original course, and *gradually* carries the enemy away."

We awake to the cognizance that all verdure has forsaken us, and now, by slow degrees, we are losing the sombre hues of e'en the pines, our faithful Alpine friends.

Another hour's ascent and we pass through a rocky-*débris*-strewn gorge. We are not yet quite forsaken, for out of the wide banks of precipitated lithic fragments shoot up, erect and green, but puny, the mountain-loving conifers—fresh, green "Christmas-trees." The rashness of their hardihood is ever and anon demonstrated by the prone bodies of their

"GREY PINES"

comrades cast down by the constantly recurring stone-slips. Altitude, however, is telling upon them. We are now well above the zone of fir and ash, and, though they look as healthy as well could be, we note their gradual diminution to mere dwarfs.

"Grey pines, companions of my solitude,
Which with the change of seasons cannot change,
Contracted to life's narrowing winter-range."

A few still cling to the rocky heights above us, sharing their inhospitable sides with alpenrose tufts and mossy patches, but their arms are thin and weakly.

Emerging from a rocky tunnel, we are startled by continuous thunder, and we know a giant cascade is at hand. We peer over the shelf of rock which serves us as our road, and lo! there is a glorious waterfall.* There it foams, thunders, sprays! Its massy waters, with hissings and roarings, leap down sheer twice a hundred feet into a narrow, rock-bound, hollow-echoing abyss. Falling unbroken until half-way down its waters strike the solid rock, there they boil and rebound in snow-like foam, from which dense clouds of spray—like steam from Antean caldron—arise to besprinkle the rocky chasm and form rainbows in the noonday sun. Beneath our feet, and from a still greater height, the silvery

* The imposing Handegg Falls.

WATERFALLS

waters of another source* tumble to join and lose their identity in the wild turmoil of angry roaring waters, whose choleric wranglings rise in thunder's voice from the depths below. What a potent demonstration of Nature's might, this wasteful expenditure of her vast yet tamable power! "Of all inorganic substances, acting in their own proper



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nature, and without assistance or combination, water is most wonderful. If we think of it as the source of all the changefulness and beauty which we have seen in the clouds; then as the instrument by which the earth we have contemplated was modelled into symmetry, and its crags chiselled into grace; then as, in the form of the snow, it robes the mountains it has made with that transcendent light which we

* The Aerlenbach.

WATERFALLS

could not have conceived if we had not seen ; then as it exists in the form of the torrent—in the iris which spans it, in the morning mist which rises from it, in the deep crystalline pools which mirror its hanging shore ; in the broad lake and glancing river ; finally, in that which is to all human minds the best emblem of unwearied, unconquerable power, the wild, various, fantastic, tameless unity of the sea—what shall we compare to this mighty, this universal element, for glory and for beauty ? or how shall we follow its eternal cheerfulness of feeling ? It is like trying to paint a soul.

“ Hast thou no rest, oh stream, perplexed and pale !
That thou forget'st, in thine unhallowed rage,
The pureness of thy mountain parentage ?
Unprofitable power ! that dost assail
The shore thou shouldst refresh ;
Fierce waters ! to whose strength, whose avarice,
The *rocks resist not*, nor the vales suffice.”*

Among the natural phenomena a mountainous land alone can present, there perhaps are none more prepollent to rivet our attention, to claim our unalloyed admiration, than waterfalls. The highest waterfall in Europe is in the Tyrol ; the most voluminous are the falls of the Rhine ; whilst, between these two extremes, Switzerland presents us with hundreds of falls, varied, indeed, in both form and

* Ruskin.

WATERFALLS

magnitude, all beauteous, but differentiating greatly in the types of their beauty. Some, like those we have just seen, are broad, loud-voiced, and forceful, forming a gorgeous link between upper and lower waters. Some leave the lofty mountain brow and with one giddy leap, clear of all obstacles, fall sheer into the valley below. This they appear to do silently and with much deliberation, for so lofty is their flight it seems long before their waters, now disintegrated into spray, reach us down in the valley. We can recall several such—appropriately called



xL.

“Mare’s tails,” “Bridal veils,” and such like.* In each case a stream

“That left so late the mountain’s
brow,
As though its waters ne’er
would sever ;
But ere it reached the plain below,
Breaks into drops that part for
ever.”

In other cases, falls, with a mighty demonstration of their power, rush and roar almost within the bowels of the mountain. Of such† we reproduce a photograph upon this page.

* As, for example, the *Staubbach*, or “dust-brook.”

† The extraordinary *Trümmelbach* falls in the Lauterbrunnen Valley.

"EVERLASTING" ROCKS

Upwards we press through cuttings of solid rock, towering far above the head of the horseshoe we are now turning. "Solid everlasting rock" it would seem to be! Seared and stained by the rains of countless ages, its true colour is denied us, dyed as it is by the exudations of organic bodies, trees, mosses, lichens, tannin, as well by metallic traces, washed down in fantastic smears, mellowed by a million lavings. Dimmed though it may be superficially, but break a piece, and, lo! it is a rich, beautiful granitic stone—white and pink granite, an Alpine Aberdeen. What a gold-mine would it not represent were it near our smoky Metropolis!



XII.

Everlasting rock, did we say? Surely not! We might think so, were it not that we have but to look around to see its wholesale disintegration on every side. Is it everlasting rock? Look yonder! There it is being erosively destroyed by the never-blunting file of the insidious stream and reduced to powder; here Nature's disintegrating machine, driven by the irresistible expansive force of ice—her million horse-power pulverizer—is granulating it; there, again, the congelating element is riving it asunder in shales like a Titanic slate-cleaver; there the rubbing, scrubbing, rasping river is grooving out

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the very base of the granitic hill, leaving to the strong lever of gravity the task of toppling its masses into the bed below. It is wasting around us on every side. Everlasting rock it is not! No! Dame Nature will not rest until in her chemical laboratory she has reduced it—as surely as did she Cæsar's body, “dead and turned to clay.” Verily, all around us changeth and decayeth!

Apart from the beauty and grandeur of these passes—the majesty of their dominating mountains, the pleasures derived from the contemplation of them, and the health and vigour imbibed with their mountain breath—what vast storehouses of knowledge, of teaching power, replete with documents of inestimable worth, wherein are inscribed the unchanging, inviolable laws of Nature, do they not constitute! Storehouses whose doors are always to be unlocked by the key of persevering research. They are Nature's *free libraries*, and if we will we may enter them, peruse their voluminous and orderly arranged *tomes*, extract from them, draw upon their endless resources, and profit by the hints they contain.

“Mountains seem to have been built for the human race, as at once their schools and cathedrals; full of treasures of illuminated manuscript for the scholar, kindly in simple lessons for the worker, quiet in pale cloisters for the thinker, glorious in holiness for the worshipper. They are great

NATURE'S COLOSSEUM

cathedrals of the earth, with their gates of rock, pavements of cloud, choirs of steam and stone, altars of snow, and vaults of purple traversed by the continual stars."*

The view around us is now† very grand. Below we see the horseshoe road we have traversed, the bridge with the torrent beneath it, both winding their sinuous ways between *débris* and huge rocky masses hurled hither and thither to tell of angry mountain torrents and their work, as well as to recall the devastating avalanche. Above and around us are giant naked monoliths whose edges have been rounded off by the sand-paper of time. Below we appreciate the rich deep green of the firs and larches, through whose graceful outspread arms and interlacing fingers the golden-tinted autumnal grass is seen. The great *Delta* of *Detruitus*, like a lithic cascade issuing from the bowels of the mountain, rushes across the gorge, arresting and destroying all vegetation save straggling blades of rank grass.

In the centre of all this rugged grandeur, and the only thing which has the temerity to break the solemn silence, is the noisy torrent hurrying forward over its white-gray, stony bed, its colour grading from the snow-white foam of its margins to the bright emeralds and deep azures of its here shallow and there deep pools. We stand, as it were, in a colosseum—a giant amphi-

* Ruskin.

† On the Handegg Alp.

ALL AROUND US CHANGETH

theatre—which Nature has built, with imposing mountains for walls, rocky clefts and terraces for steps, a stone-bestrewn bed for its tessellated pavement, and an azure canopy for its cupola. Some of these immuring heights carry on their ample shoulders pale green-white glaciers. Yonder is one* squeezing its cold body between rocky ridges, with its mountain mother watching over it. Silent and stately stand the sisters and sponsors, one holding in her lap the high-placed lake with which she feeds the babe we see fleetly escaping, babbling, dancing, and gambolling down her shelving gown to join the elder child, swiftly running below. Higher, again, above the white caps of the silent dames, is spread a speckless expanse of sapphire sky. To the grandeur of the scene the perfect silence adds solemnity.

Centuries past it was quieter still, for then the entrancing arena of to-day had *no* scenery, was but a block of solid and imponderable ice. Stroll yonder along the disused bridle-path,† clamber over the huge rocky slabs abraded and planed down so smooth that the natives call them *hehle-platten*, or slippery blocks, and see what the slowly moving million-ton ice-block has wrought. These inscriptions by the hand of Nature, these scorings on the stones, speak to us in a written and readable language of the *past*, as impressively, as intelligibly, as the hiss

* The Aeren.

† In the Grimsel Pass.

ALL AROUND US CHANGETH

of the wind, the roar of the torrent, the rush of waters down the mountain-side, the grating of the sliding stones, and the thunder of the avalanche, speak to us of the future in an audible tongue to-day, telling us yet again that centuries to come have still vast changes in store for each



XLII.

deep and impressive gorge. Verily, all around us changeth !

As we double the headland we see nothing but rock, rock carved by Nature's sluggish but wanton chisel into fantastic forms, out of which, had we time, we could conjure up forms weird and uncanny, as children do in smouldering embers. Now the

NATURE'S GRAVING TOOLS

gorge widens out into a place, cold, barren, desolate—we scarce know how to style it. A valley? Scarcely, for with a valley we associate grass and trees; but here—

Trees, ah! where are they?
Ask the stones that all around
In sullen silence lay.

A gorge? Nor that neither, for it is too wide for one. Say rather a Devil's punch-bowl, wild and weird, now dry save for the scanty nectar of the impotent embryo streamlet slowly meandering noiselessly, and scarce observed, over its rocky bottom. From base to tip the bowl is formed of rocky ware mottled and arabesqued by a network of snow-veins etched by glacial gravers.

No living thing is near us, the silence is such as can be felt, the solitude is perfect—thrilling. In such solitude, in the immensity of mountain heights, in the expanse of the Alps' tremendous steeps, we feel our puny puissance, we feel the minuteness of our individuality, we feel useless, we feel sad. Enough and to spare of silence have we here, of stone and solitude. The devastation wrought around us goads us into action, the change around tells how very soon our own must come: let us be up and doing our puny best for those around us.

“This awful silence
Forbids the mind to view with careless eye
Creation's works, or uninstructed gaze.”

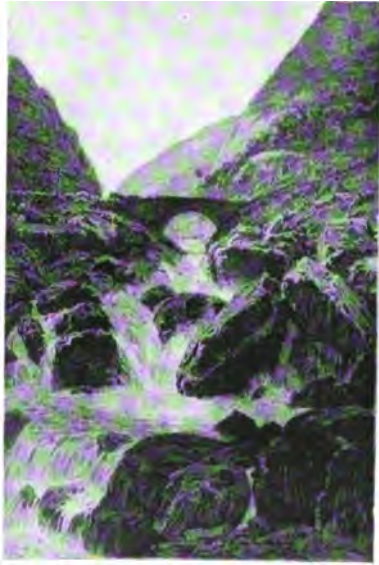
WE ASK OF THE MOUNTAINS

Such sights, awful in their majestic magnitude, thought inspiring in their mountain solitude, set us pondering, questioning, and surely the first question we ask is, Who are Nature's masons ?

We ask of the mountains :

"Teach us your wisdom, patriarchs ! Ye have stood
Patient these thousand years, nor thought it strange,
Yourselves unstirred, to watch in farm and grange
Man's transitory race ten times renewed."

We have not descended a thousand feet ere the mountains themselves answer audibly, and this in no feebly expressed manner. The roaring torrent cries aloud, "I, water, am one of Dame Nature's toiling masons." Scarce have we time to reflect upon the truth of this when we are startled by the loud-voiced avalanche, and the awful reverberations re-iterate, "Water, water ; 'twas water cast me down !"



XLIII.

Then we recall that of the five hours of upward

MOUNTAIN POOLS

toil, scarce five minutes have we known apart from the sound of rushing waters—

“Where the dread peal of swelling torrents filled
The sky-roofed temple of the eternal hills.”

And were we crassly unobservant, the fact would have forced itself into our knowledge that it was the rushing waters that had chiselled and carved out the sinuous, rugged, and glorious pass. They were Nature's masons.

But what of the avalanche? That seems less apparent. It is all so wonderful; let us spend a few minutes in considering it. In coming upon one of those lovely, deep-blue little lakes, entrapped, as it were, far up amid the mountain-crests, nothing would be farther from the ordinary mind than that such a beauteous and quiescent jewel, a sapphire in a rocky setting, should engulf, dormant in its depths, a wondrous might. Yet it is precisely because we find it thus entrapped at such vast altitude that its might is so potent. Give it but its mallet and chisel in setting it free, and it will show that it, unaided, can gash and chip and change the face of Nature.

Such a quiescent mass of water* is close at hand, for, nearing the top of the pass,† the almost perpendicular walls of rock suddenly open out, and disclose

* The beautiful, the tranquil lake at Gletsch.

† The Grimsel.

MOUNTAIN POOLS

a calm and secluded lake covered with huge masses of ice. The rocky mountain-summits towering above us appear as the giant posterns to the gorge, and these are of especial interest, for they bear on their smoothly-rounded forms the groovings and scorings of prehistoric ice-masses, which, backed up with resistless pressure, were, ages ago, forced through the portal to groan and grate their descent through the whole course of the Haslethal, up which we have so enjoyably, albeit laboriously, ascended.

All around is still, solemn, and stupendous, in stern, rocky ruggedness; but sweeping round the headland, we come upon the placid lake, and, climbing a hundred feet above it, sit down upon the hard, unyielding snow to contemplate the sombre yet beauteous scene.

The sun had set, but the sky was still of that ravishing light-blue to be seen only after sunset in the Alps. The effect of this upon the calm and placid surface of the water was indescribably beautiful. So absolutely dead and still was it that the rugged frame of its desolate basin was reflected with a reversed image of startling sharpness and faithfulness of form; in fact, in the dim light it was most difficult to define where shadow began and substance ended. It would be difficult to find a more uncommon, though purely natural and solemn, scene. All around are mountains, rocky, naked, and cold, with snow-patches and giant icicles, each and every

A HIGH PERCHED LAKE

detail—the most minute—being faithfully mirrored in the black waters, even to the relieving green of the lichen. The image of the wild mountains was in a setting of ethereal blue, for the salmon-pink, which the afterglow had delicately merged with the azure, had now disappeared, and in its stead myriads of stars, some of a brightness never to be seen in lower altitudes, shone up from the placid face of the water as if beneath its surface the lake were of molten silver, with its superficies punctured in a million places, through which we could see something of the argent splendour below; for the stellar lights throbbed and scintillated as a seething mass of molten mercurial silver might have done. A promontory divides the lake into two approximately equal portions, of which, to our great surprise, one was frozen over, whilst the other contained not a fleck of ice.*

Yet another is close at hand, for, leaving this sombre, motionless water, the road ascends in steep zigzags up to the Hausegg (7,100 feet), where, in silent solitude, lies the "Lake of the Dead," or *Todtensee*. Veritably it is a lake of the dead in more than one sense; it is as dead in its deadly silence, whilst its stony basin formed a receptacle for the dead when, in 1799, French and Austrian met by its margin, fought, bled, died, and were buried beneath its waters.

* One would be glad to learn the physical reason for this.

THE PERSISTENT DROP

Looking at such mountain masses of water, so absolutely inert, it is difficult to realize that they contain, in potential form, vast energy—equivalent, indeed, to that of thousands of horses—and more difficult to appreciate that to place them here has necessitated the expenditure of thousands of horsepower.

What a hard-working mason water is we have learnt, in a manner we shall never forget, as we have trudged up beside the *Aare* to-day, but here the workman has displayed the cunning of his handicraft in ostentatious style. Nevertheless, what he does there so noisily is as nothing to what he is doing all around us incessantly and almost noiselessly.

The persistent drop weareth away the stone, and it is the incomprehensible multitude of these ceaseless runnings and drippings which doth most in the engraving of Nature. We will leave it to Ruskin to explain :

“Close beside the path by which travellers ascend the Montanvert from the Valley of Chamounix, on the right hand, where it first begins to rise among the pines, there descends a small stream from the foot of the granite peak known to the guides as the *Aiguille Charmoz*. It is concealed from the traveller by a thicket of alders, and its movement is hardly heard, for it is one of the *weakest* streams of the valley. But it is a constant stream, fed by a

THE PERSISTENT DROP

permanent, though small, glacier, and continuing to flow even to the close of summer, when more copious torrents, depending only on the melting of the lower snows, have left their beds 'stony channels in the sun.' The long drought which took place in the autumn of 1854, sealing every source of waters except these perpetual ones, left the torrent of which I am speaking, and such others, in a state peculiarly favourable to observance of their *least* action on the mountains from which they descend. They were entirely limited to their own ice-fountains, and the quantity of powdered rock which they brought down was, of course, at its minimum, being nearly unmingled with any earth derived from the dissolution of softer soil or vegetable mould by rains. At three in the afternoon on a warm day in September, when the torrent had reached its average maximum strength for the day, I filled an ordinary Bordeaux wine flask with the water where it was least turbid. From the quart of water I obtained twenty-four grains of sand and sediment more or less fine. I cannot estimate the quantity of water in the stream; but the runlet of it at which I filled the flask was giving about two hundred bottles a minute, or rather more, carrying down, therefore, about three-quarters of a pound of powdered granite every minute. This would be forty-five pounds an hour; but allowing for the inferior power of the stream in the cooler periods of the day, and taking into consideration,

PERISHING HILLS

on the other side, its increased power in rain, we may, I think, estimate its average hour's work at twenty-eight or thirty pounds, or a hundredweight every four hours. By this insignificant runlet, therefore, rather more than two tons of the substance of Mont Blanc are displaced and carried down a certain distance every week ; and as it is only for three or four months that the flow of the stream is checked by frost, we may certainly allow eighty tons for the mass which it annually moves. It is not worth while to enter into any calculation of the relation borne by this runlet to the great torrents which descend from the chain of Mont Blanc into the Valley of Chamounix. I but take this quantity, eighty tons, as the result of the labour of a scarcely noticeable runlet at the side of one of them, utterly irrespective of all sudden falls of stones and of masses of mountain (a single thunderbolt will sometimes leave a scar on the flank of a soft rock looking like a trench for a railroad), and we shall then begin to apprehend something of the operation of the great laws of change which are the conditions of our material existence, however apparently enduring. The hills, which, as compared with living things, seem 'everlasting,' are in truth as perishing as they ; its veins of flowing fountain weary the mountain heart as the crimson pulse does ours ; the natural force of the iron crag is abated in its appointed time, like the strength of the sinews in a

THE PERSISTENT DROP

human old age; and it is but the lapse of the longer years of decay which, in the sight of its Creator, distinguishes the mountain range from the moth and the worm."

We have chosen this extract from Ruskin because it refers to a "rough-and-ready" experiment, which, being devoid of experimental details and technicalities, and so simple, will the more readily appeal to the general reader. Needless to say, carefully conducted, quantitative experiments have been made upon the erosive effect of rivers and streams; but the figures representing the vast amount of material removed from the mountain-sides and highlands, and transported annually to the lowlands, are so enormous as to be quite incomprehensible, and incapable of appealing to our senses as a concrete idea of material magnitude.

Some conception, however, may be formed if we consider the work done by single rivers. Ruskin has thus shown that "a scarcely noticeable rivulet" is responsible for the yearly removal of eighty tons or more from the mass of Mont Blanc, whilst it has been calculated that in *a single week* the Ganges alone carries away from the soil of India and delivers into the sea twice as much solid substance as is contained in the great Pyramid of Egypt. Again, the Irrawaddy, according to Sir J. Herschel, sweeps off from Burmah 62 feet of earth in every *second* of time. There being 86,400 seconds per day, this

RAIN LAVING

mason thus rasps off the face of the earth 5,356,800 cubic feet, or 239,143 tons, as its day's work, the sweeping up of this mason's annual chippings from the face of Nature being therefore equivalent to a truly enormous heap—a veritable mountain, weighing close upon a thousand million tons.

Such a crude measurement as that of the earth washed down by the streamlet appeals to ready comprehension, but we do not, perhaps, at all correctly or adequately appreciate the enormous yet quiet work done by the rain in gently laving the surface of the Earth. The pattering of the rain, its bombardment by innumerable projectile droplets upon the sodden soil, indents it, whilst its flowing over the softened surface slowly but surely sweeps it away, and this to an extent far beyond that we are likely to give it credit for. We see the masonic torrent and the pastoral brook each performing its task in proportion to its physical strength, the one shouting in its angry might, the other warbling its drowsy lullaby, and we appreciate the toil of each; but do we in any adequate measure credit the fitful shower or the softly falling rain, spreading in grateful humidity the broad acres welling away towards the uplands on either side of the streamlets, with its share in the daily "toil"? We think not; yet to the softly falling rain both stream and torrent owe their birth. To its gentle laving we are indebted for the beauteous, graceful, undulous carving of the

RAIN LAVING

land which pleases our senses and sustains our being. Silent, gentle, unobtrusive, all-pervading, its work is prodigious.



XI.IV.

Were the riverian chisel the only tool wielded by Dame Nature's masons, our landscapes would alone be sculptured in defined though tortuous groovings. A most interesting exemplification of this is shown

RAIN LAVING

in the adjoining photograph, where we see the hard crust of the earth profoundly furrowed out in sinuous course by the loftily constraining chasm walls. Rivers, moreover, would evince a monotonous uniformity of width. But rain, by its imperceptible lavings, shelves the banks, broadens the streams, excavates the verdant vales and hollows, throws up the grassy knolls, the sandy monticles, fashions the shady dells and tree-hung ingles, displaying the while, in silent prepollence, power far surpassing the power of stream and river, the forceful might of torrents. Indeed, these labourers borrow but a fraction of the energy of rain. The power actually at work in the clouds, in transporting their vast weight across the face of the earth and in setting them free to descend in rain, and so, indirectly, in levelling the Earth's surface, is indeed enormous, almost baffling comprehension. For when we reflect we find that the amount of heat required to evaporate a quantity of water sufficient to cover an area of only a hundred square miles to a depth of but one inch would be equal to the heat produced by the combustion of no less than half a million tons of coal, and that the amount of energy this consumption of heat would develop would be the equivalent to that required to raise a weight of over *one thousand millions of tons to a height of one mile*. And, again, when we remember that the land surface of our Earth amounts to some fifty millions of square miles,

RAIN LAVING

we perceive—though we cannot comprehend—how enormous must be the power for masonic work each year of the rainfall of our Earth. We certainly overlook, when contemplating the silent and seemingly easily performed processes of the formation of the rain and its laving into familiar forms our country-sides, the tremendous energy incessantly being expended upon the work. Indeed, in flat or but slightly undulating countries it may quite escape our atten-



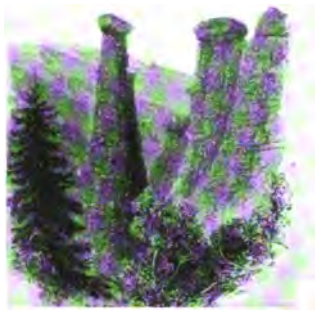
XLV.

tion. In the photograph reproduced on this page—the work of rain—the washing into form of a sandy tract of country, which it has fashioned into a beautiful stratified monticle and a boulder-bestrewn plain, is most eloquently and interestingly depicted.

To turn from the stupendous to the miniature, we do not know of a place where the sculpturing by gentle aqueous erosion may be more

RAIN LAVING

conveniently and more interestingly studied than at Grange-over-Sands in Westmoreland. There we find a great estuary only occasionally submerged by the inflowing of the sea, whilst frequently subjected to storm and shower, and there, as we wade ankle and knee deep in the mud, we can study the rain's work in rapidly throwing over the dreary and monotonous expanse a tracery of inceptive runlets. There one can distinctly trace the birth of pigmy streams, their rapid widening, the merging into their baby waterways of confluent streamlets, their growth to rivulets and rivers, the grooving out of steep ravines, the hollowing out of broad valleys, the torturing of their courses by obstacles and their consequential



XLVI.

détours, their Liliputian leaps and waterfalls—their “scars” and their “forces,” as our North-countrymen would style them—their gradually accelerated flow, their metempsychosis into embryo lakes, their demise upon the fringe of the ocean—all this in a manner giving us an excellent insight into the *modus operandi* of the sculpturing hand of rain in the colossal architecture of the mountains.

Not far beyond these enchanting Alps, so potent

ÆOLUS THE MASON

to set us thus thinking, is an entrancing exemplification—quaint and grotesque some might say—of the effect of rain-washing. We refer to the “clay pillars” to be found in the Dolomite Mountains. These extraordinary samples of the handicraft of Dame Nature’s masons, as will be seen from our photograph, are huge columns and pilasters of soft agglomerated soil, each surmounted by a capital in the form of a huge boulder, which, unlike the work of the human mason, has been made to form the foundation stone from which the column and pilasters have been reared. Needless to say, these capping-stones once lay quiescent upon the flat earth, and this they effectively protected. But what of their surroundings? Upon these the rain had full and unhindered play, with the usual result, that it appropriated them and carried them off to cast them in the nearest river ; but the lithic hardness of the boulders defied the rain, and rose and rose triumphantly aloft above the neighbouring dissolution and desolation, until they stand to-day monuments to the unwearying industry and prepollence of the lavings of rain.

In leaving this subject we must not forget to mention the name of yet another mason—Æolus, the worker wind. He is as erratic in his workings as he is fitful in his application ; often so calm and placid in his demeanour that we forget his existence, then in unexpected and blustrous zeal he will effect much we would fain have had him leave undone. Then,

ÆOLUS THE MASON

again, sometimes he will cast down and carry away, at others he brings material from afar and sets to work to build. To catch him at work we have only to stroll the bleak and barren coast of East Anglia ; there we see him fetching, carrying, building, burying, or if we climb the mounds and monticles—the Dunes—behind Schavening, we at once appreciate that they are of his building. Sometimes he turns his hand to sculpture, and his *chef d'œuvres* are always uncanny and grotesque. A very interesting bit of wind sculpture is shown in our photograph.

One other process employed by the sculptors of Dame Nature's



XLVII.

laboratorium should be referred to. We have spoken of the bodily and material removal of the matter composing the Earth's crust, but it must be remembered also that, apart from erosion, water has the power of carving the face of Nature by other means, silent and invisible, for it dissolves certain parts of the solid substance of the land, carrying them away in chemical solution. This, as

DISSOLUTION

we have said, it does quite invisibly, and the work this mason does in this way is very great—far more than we should at first have imagined—yet his colour and transparency are not visibly affected. It is, however, difficult to make ourselves believe, in viewing the translucent and crystal waters of mountain lakes, that in their gemlike purity they are supporting upon liquid shoulders vast burthens of earth and rock. Yet this is veritably the case, and, indeed, it is not difficult to make an approximate estimate of the amount and weight of such invisible mineral thus held and carried by rivers.

The celebrated chemist Bischoff calculated that the Rhine carries past Bonn every year enough carbonate of lime, chemically dissolved in its waters, to form the shells of three hundred and thirty-two thousand millions of oysters of the usual size, and that if all these oysters could be put together they would form a cube measuring 560 feet on each of its sides. The dancing waters of the river at that beautiful spot, therefore, annually bear along a burthen equivalent to the transportation of dozens of lithic masses known as Cleopatra's needles. The Rhone, it is estimated, carries past Avignon every year dissolved mineral salts to the enormous aggregate of more than eight and a quarter millions of tons.

The consideration of such vast figures can but impress upon us how transient are the mountains, and, indeed, the Earth beneath them ; for this *modus*

NATURE'S MINERS

operandi upon the part of this one of Dame Nature's masons constitutes him also a miner of no mean labouring capacity, for in this way he also quarries out from the bowels of Earth millions of tons, and transports them to the ocean. The quarrying operations are, indeed, not the least interesting of the change-producing work, the quarries, caverns, *grottes*, and fissures forming so-called natural "curiosities," greatly adding to the enjoyment of the Alpine visitor; for, not content with excavating huge subterranean dwellings, the sculptor supplements his work by decorating them, giving them glistening and jewel-bespecked walls, domed and groined ceilings hung with crystal finials and translucent alabaster stalactites, whilst he tessellates the floors with quaintly-shapen. many-hued stalagmites. In our photograph is seen a huge rocky cavern beneath a mountain, with its domed ceiling hung with stalactites, whilst its floor is plentifully bestrewn with acutely-pointed stalagmites, a point to direct the attention being that the one usually forms beneath the other, each continuing to grow* until, in many instances, the one uprising and the other descending, they join to form a lovely column reaching from floor to roof, and appearing to be of a ravishing, translucent marble or amethystine alabaster.

*" Ces beaux salons de rocailles ornés,
Sans le secours de l'art, avec art ordonnés ;*

* See Appendix.

"TO THE SEAS"

*Ces superbes piliers dont la cime hardie
Observe en s'élevant l'exacte symétrie ;
Des rocs, qui des rubis dardent tous les rayons ;
Ce buffet d'orgue prêt à recevoir des sons ;
Ces ifs qui, sans les soins d'une vaine culture,
S'échappent tout taillés des mains de la nature."*

From these remarks one appreciates that the face of Nature—indeed, her very substance—far from being, as the ancients believed, everlasting, rigid, and immutable, is in ascertained fact perennially



XLVIII.

plastic; that year by year, day by day, its superficies changes, its very substance succumbs to metamorphic change; that her hardest, densest rocks—

types of solidity—are slowly but surely being rasped away, her lithic excrescences filed off by mechanical attrition, her solid substance softened by chemical decomposition, disintegrated by frost, and the "soil" thus formed being swept away by wind and water. But whence? To the seas, and even the mighty ocean combines forces with these transmutators, for she, too, lashes insidiously and effectively at her solid basin of rock or her shelving beaches of sand or shingle. All are hard at work, yet all are taking

THE HILLS ARE SHADOWS

part in a vast funereal rite ; they are burying the land in the depths of the ocean.

Strange, indeed, that the doings upon the surface of our Earth remained unnoticed and unstudied long after celestial worlds, millions of miles from our own, had been watched, their movements registered, their habits studied. Strange to find that even eighteenth-century philosophers were but groping in their attempts to study what has now become almost an exact science—geology. It was to the intelligence of Dr. James Hutton of Edinburgh—physician, farmer, and manufacturing chemist—that the fact was revealed that “all around us changeth” ; that, as Tennyson tells us at the opening of this chapter, “The hills are shadows, and they flow from form to form.” It was to his prescience shown that, as in the present “there rolls the deep where grew the tree,” so in the future it shall be, and that where to-day the long streets roar shall be the stillness of the central sea. One is apt to look upon the “dead” earth as typical of inertia, yet when we consider its incessant transmutation scarce are we justified. Indeed, almost might we say with the poet :

“ Life, dread power, in thee
Is strong as in cherubic wings that wander
Searching the limits of Infinity.
Life, life to be transmitted, not to expire
Till yonder snowy vault shall melt in the last fire !”*

* Aubrey de Vere.

ISLANDS EMERGE BUT TO SUBMERGE

Concurrently with the entire disappearance of some islands and the observed lowering of the level of continents, it is known that certain parts of the world's crust are rising. Thus Playfair, in 1802, discovered that the coast-line of Sweden is rising at the rate of from a few inches to several feet in a century. This was subsequently corroborated by Buch. Darwin, again, by his observations proved that Patagonia is rising, whilst Pingel showed that Greenland is slowly sinking.

A pleasing feature in regard to such research and to the acquisition of knowledge reveals itself when we consider that the world now listens eagerly and without prejudice to new doctrines, for this latterly acquired attitude marks a marvellous intellectual growth of our race. What a gratifying contrast, is it not? to the attitude evinced in darker ages and not so long ago—scarce a trice of centuries—when Bruno was burned at the stake for teaching that our earth is not the centre of the universe; a couple of centuries only since Newton was pronounced “impious and heretical” by a large school of philosophers for declaring that the force which holds the planets in their orbits is universal gravitation. A hundred years later, again, the French savant Laplace and our philosopher Herschel are honoured by teaching that Newton's gravitation built up the system which it still controls; that our universe is but a minor nebula, our sun but a minor star, our

SCALING AND SHALING

earth a mere atom of matter, our race only one of myriad races peopling an infinity of worlds—doctrines which but the span of two human lives before would have brought their enunciators to the stake are now pronounced not impious, but sublime. Let us, however, return to the work we see Dame Nature's masons engaged upon around us amongst the Alps.

In addition, and concurrently with the more gradual disintegration of the mountains by aqueous lavings, by the persevering erosion of streamlets, we have the giant scaling and shaling, the intermittent and immense rock and stone slips. These, again, take place through the instrumentality of water, but in this case by the intervention of the great force of expansion due to frost.

The more common *modus operandi* may be told in few words. Everyone who looks at all attentively at the naked sides of the mountains will see that they are mottled and veined; that is because the rock is not a perfectly homogeneous mass; it is softer at some places than at others; it is fissured by a million cracks, some tiny, some larger. The clouds and mist beating against their cold sides are condensed, and their waters run down them like perspiration, but, instead of being exuded out of the pores, it is absorbed *into* the porous body of the stone. Now, water is at its densest at 4° F. above freezing. Hence it expands if you warm it, but it also expands if you cool it, and at the moment

SCALING AND SHALING

when it freezes, when congelation takes place, it expands suddenly and with tremendous force, as every householder knows to his cost when his water-pipes are suddenly split asunder—or, rather, he does *not* know it and does not suspect it, until “one fine day” a *thaw* sets in, and his water promptly sets out. Now, what takes place in the water-pipes is taking place almost constantly in the pores of the mountain-rock. The freezing of the occluded water bursts open the pores and disintegrates the rock, to be washed down as a kind of sandy mud.

This explains why one so often sees vast faces of rock, when placed vertically or at an acute angle, absolutely without vegetation, and always looking as if newly cloven. On flat or obtusely sloping faces disintegration is for ever going on, but the pulverized rock or soil is not so readily washed away, and hence affords root-hold for vegetation, whereas the scales fall from the vertical face and for ever expose fresh surface to be acted upon. In our miniature photograph we see such a face of vertical rock looking fresh and white, with the roadway cut in its face, almost imperceptibly rounding the rugged headland.

But the giant strength of frost does not always do its work so noiselessly. As the water runs down the rocks, it washes out the sand as we have explained, and carries it forward like sharp emery paper, scouring out the little veins into larger channels. This continues until some of them have become quite

THE AQUEOUS QUARRYMAN

deep. Then the water lodged in them suddenly freezes *en masse* and blows out the side of the rock, which comes tumbling down the face, gouging out channels in the softer, and snapping off the projections of the harder parts. You cannot see the slower disintegration by means of the pores to which we have referred by casually looking at the mountain, but you have only to carefully examine a stone church or other building in your own town to see its mode of action. Poor dear, black-faced old St. Paul's will do very well, or the ornate building beneath the bold-faced, gilded, crested "Big Ben," where our legislators alternately boil up the blood of their *confrères*, only to freeze it again with their weather-cock changes. To try to put a stop to this ever-crumbling, everything-destroying predilection of "Jack Frost," buildings are sometimes washed over with a silicious compound, with the object of preventing the water ever getting into the pores, and the wonder is it is not more resorted to. We believe the Houses of Parliament have more than once had their faces washed over with this Madame-Rachel-like "wash."



XLIX.

When the expansive force of freezing water is

THE FRIGID QUARRYMAN

exerted *en masse* in this way, the monoliths detached are often of enormous weight and dimensions. The ancient Egyptians had recourse to the irresistible expansive force of water, for they had no potent dynamite to blast out their great stones in quarrying their stupendous monoliths. To burst out of the solid rock an immense monolith—"Cleopatra's Needle," for example—they drilled a number of holes in lines corresponding to the shape of the monument they desired, and into these they firmly drove wooden wedges, but all their hammerings would have availed nothing towards the splitting out of the mass. They therefore simply *wetted* the wedges, when, the water expanding the woody fibre, the monolith was blown out, as it were, of the solid rock.*

The devastation wrought by the descent of a frost-detached boulder of giant proportions must be seen to be appreciated. On one occasion we calculated the cubic contents of such an one as that seen in our photograph, and assuming it to be endued with high velocity, such as would be imparted to it in falling from far up the mountain, found that its impact

* During the intense cold of last winter, a thoughtful quarry-master at Aberdeen, having a row of blast holes ready to receive the dynamite cartridges, suspecting a keen frost at night, filled the holes with water, omitting the wedges of the Egyptians, and was gratified to find in the morning that his huge block, weighing over forty tons, had been economically burst out during the night.

THE FRIGID QUARRYMAN

would be quite comparable with that of a locomotive travelling at sixty miles per hour.

We have but to look up at the bold Wetterhorn and many of his brothers and sisters to be filled with wonder that the great scales, splinters, and shales, which are in course of preparation for this natural dynamic blasting, do not come down almost as we look at them. We have, however, but to take our cycles over some of the rocky passes in winter, when the roadsmen have been withdrawn, to see that the falls are continuous, for we need continually to steer clear of fragments. Indeed, on more than one occasion weighty blocks, heavy enough to deal death, have fallen quite close to us, whilst we know of places where lithic cascades—gentle, but incessant—are to be witnessed under certain conditions.



L.

There is yet another manner in which frost causes vast masses of mountain to descend to the lowlands, slowly and noiselessly. One often hears it stated that land and even roads are rendered “rotten” *after* frost, yet these same roads and land were hard as stone itself *during* the frost. The explanation is that frost “attacked” them at a time when they were *saturated* with water, every interstice, in fact, being full of water; this being so, it is clear that

THE PLASTIC SCULPTOR

these interstices must be forcibly enlarged at the moment of freezing, so that on thawing the mass of mud finds itself so spongy and honeycombed, and its cohesion so impaired, that it is unable to support the weight of the imprisoned water and remain upon the sloping mountain-side. Hence it sometimes happens that the greater part of the side



II.

of a mountain will commence to slowly descend into the adjoining valley. Only recently a great sensation has been caused by such a phenomenon—an enormous landslide in the Val de Travers, which, should it be continued in winters to come, might, were the help of the engineer not sought, block a railway, deviate the course of a river, and establish a lake where now is a smiling valley.

GREAT LANDSLIPS

In our photograph we see the mountain, La Clusette, about half way up which will be noticed the great black, gaping chasm, formed by the slipping down of the lower part of the mountain into the Val. On the commencement of the movement sounds like thunder were heard in the workings of the cement mines adjacent, and the timber in the galleries broke like matchwood. The bulk of the mass still threatening to descend is computed at half a million cubic metres. An immense "slip" of this nature occurred in 1893 in the Himalayas, when the portion of the mountain which descended blocked a river and gave rise to the Lake of Gohna; the falling mass is computed to have weighed no less than eight hundred million tons.

"But were there not masons before water, frost, and rivers?" we are constrained to ask, and the answering takes us into the realm of entrancing speculation—of most recondite and interesting research.

"When did the great spirit of the river first knock at these adamantine gates?" inquires Ruskin. "When did the porter open to it and cast his keys away for ever, lapped in whirling sand? I am not satisfied—no one should be satisfied—with that vague answer, 'The river cut its way.' Not so. The river *found* its way. I do not see that rivers in their own strength can do much in cutting their way; they are nearly as apt to choke their channels up as to carve them out. Only give a river some little

MASONS BEFORE RIVERS

sudden power in a valley and see how it will use it. Cut itself a bed? Not so by any means, but fill up its bed, and look for another in a wild, dissatisfied, inconsistent manner—any way rather than the old one will better please it; and even if it is banked up and forced to keep to the old one it will not deepen, but do all it can to raise it and leap out of it. And although, wherever water has a steep fall, it will swiftly cut itself a bed deep into the rock or ground, it will not, when the rock is hard, cut a wider channel than it actually needs, so that if the existing river-beds, through ranges of mountains, had in reality been cut by the streams, they would be found, wherever the rocks are hard, only in the form of narrow and profound ravines.”*

If this reasoning be correct—and there is but little doubt it is so—there *must* have been masons before rivers—nay, e’en before water—artists who modelled in plastic material before it had cooled to solid rock; for we must not forget that our *solid* earth was once not more solid than the gas-flame by the light of which we pen these lines.

Imagine that same gas-flame to be spinning round at express speed, and we gain some conception of the incandescent nebula of which our world consisted before it had attained to concrete form, and cooled to such solidity as would give any of our present inanimate artists and lifeless workmen foot-

* See Photograph XLIV.

UPHEAVALS

hold upon it ; and when it did, what was its form ? Just a great smooth stone ball, shall we say ? a giant marble, incandescently hot outside, molten within.

The first idea prevalent regarding mountains was that they all owed their origin to Titanic convulsions, which took place in the interior of the earth as it gradually cooled down to its present solid state. Owing to these stupendous upheavals, we were told, the crust was pushed up from below, tossed into billows of which the crests were the mountains and the hollows the valleys. If this had been the state of things, what would the "face of Nature" have looked like *then* ? Imagine a vast array of waves, thousands and thousands of feet in height, suddenly thrown into being and as suddenly transfixed, as if some ice giant had thrown a mantle of chilling blast upon our world, and frozen these billowy bands of the earthly crust into hard, immovable masses.

But this theory, though having much of truth within it, cannot be substantiated as a permanent, incontrovertible fact. Some of our mountains, however, owe their being to convulsions of the earth's crust, and are known as "Mountains of Elevation." This glorious Alpine chain consists of "mountains of elevation," but there are other modes by which mountains have been formed which owe nought to any such convulsions. Therefore, the first theory

THE SHRUNKEN APPLE

embraces too broad a view, is inaccurate in many details, and is also not in its application universal.

Have you ever considered the surface of a shrivelled apple : how its brown skin is wrinkled and marked, ridged and furrowed, mountained and valleyed ? That apple has shrivelled owing to a great part of the water in its substance evaporating,



LII.

and so making the remaining cellulose more solid. It has shrunk, and hence is smaller than it was, and so also has the skin, and this becoming more tightly drawn in some regions, has caused furrows or valleys to form, the lesser shrunken regions now appearing as ridges — or mountain chains — beside

THE SHRUNKEN APPLE

them. Here on your apple-skin you now have mountains and valleys ; but if you are growing old, you also have them on the backs of your own hands.

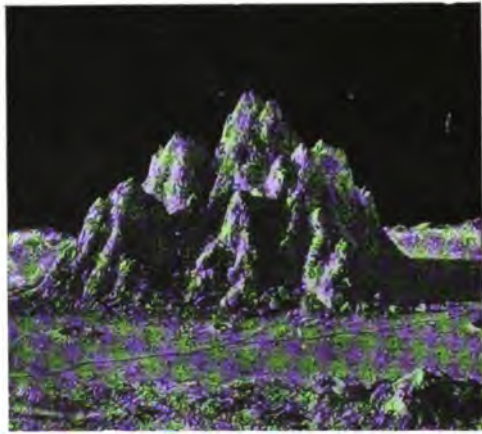


I.III.

The first to draw this interesting analogy between the human cuticle and mountain ranges was James Nasmyth, the celebrated engineer, and in our photo-

THE SHRUNKEN HAND

graph we reproduce his own hand taken by himself,* upon which we see in a very remarkable manner the resemblance to mountain chains and valleys. After a busy life, during which among many inventions he perfected his steam-hammer, Nasmyth retired to Hammerfield in Kent, and there devoted himself to



I.IV.

astronomy, constructing his own stellar telescope. Speaking of the earth's cooling and mode of contraction, he says :

“ It was in reference to this very interesting subject that I made a drawing of the great isolated volcanic mountain, Pico,† about 8,000 feet high.

* We reproduce this interesting photograph, with the two succeeding drawings by him, from the “ Life of James Nasmyth ” by Dr. Smiles, with the kind permission of Mr. John Murray.

† See succeeding photographs.

THE SHRUNKEN HAND

It exhibits a very different appearance from that of our mountain ranges, which are, for the most part, the result of a tangential action. In the case of the earth, the hard, stratified crust had to adapt itself to the shrunken diameter of the once much hotter globe. This tangential action is illustrated in our own persons, when age causes the body to shrink in bulk, while the skin, which does not shrink to the same extent, has to accommodate itself to the shrunken interior, and so forms wrinkles—the wrinkles of age. This theory opens up a chapter in geology and physiology well worthy of consideration. It may alike be seen in the structure of the surface of the earth, in an old apple, and in an old hand.”

“These illustrations,” he continues, “serve to illustrate one of the most potent of geological agencies which has given the earth’s surface its grandest characteristics. I mean the elevation of mountain ranges through the contraction of the globe *as a whole*. By the action of gravity the former larger surface crushes down, as it were, the contracting interior, and the superfluous matter which belonged to the bigger globe arranges itself by tangential displacement, and accommodates itself to the altered or decreased size of the globe. Hence our mountain ranges, which though apparently enormous when seen near at hand, are merely the wrinkles on the face of the earth.”

The lunar mountains, on the other hand, some of

THE SHRUNKEN APPLE

which are shown, owe their origin to volcanic action, a mode of mountain formation which has not played an important part in regard to the Alps.

Let us enlarge the apple to which we have referred, to the size of our earth. Then imagine a portion of its surface getting more solid, and hence contracting and sinking in, so causing an enormous lateral pressure which would bring about the building up of a line of heights along the side of this depression, and you have a good exemplification of how the Alpine chain was built up by the cooling down of the Mediterranean basin. There the contraction was terrific in its power, the lateral compression being indeed vast, so that the various *strata* of rocks composing its side yielded unequally, foldings and contortions arose along the lines of weakness, and hence came our mountain-chain with its interlying valleys.

But these same Alps are young in the history of the world's formation; they correspond to the tertiary period of the London clay. Hence they are but weakly built: earth, sand, shale, and but loosely-joined rock form the greater part of their structure, far different from those grand old monoliths of Scandinavia, which have stood the battering of all the ages since first they came with the beginning of solid rock on the earth's surface.

The Alps—a grand range to-day—are yet, geologists assure us, some three or more thousand feet

AGE OF THE ALPS

less in their majestic height than when they were first thrown up towards the blue canopy of space.

When they were first thrown up! What a glorious vista of retrospective speculation the phrase inspires! *When* they will be no more. What a baffling incoherency of thought and yearning of comprehension concerning the unthinkable space of solar time!

“ When your strength shall fail,
Ye hills coeval with the world, say what
Shall 'scape the gen'ral ruin? Empires, seas,
The universe itself shall grace your fall,
And dying Nature perish in the wreck.”*

“ What more,” said Hutton long ago, “ is required to explain the configuration of our mountains and valleys? Nothing but time. It is not any part of the process that will be disputed, but after allowing all the parts the whole will be denied, and for what? Only because we are not disposed to allow that *quantity of time* which the absolution of so much wasted mountain might require.”

As Lyell has remarked in his “ Principles of Geology,” our position as observers is essentially unfavourable when we endeavour to estimate the nature and magnitude of the changes now in progress. As dwellers on the land, we inhabit about a

* George Keats.

AGE OF THE ALPS

fourth part of the surface,* and that portion is almost exclusively a theatre of decay, and not of reproduction. We know, indeed, that new deposits are annually formed in seas and lakes, and that every year some new igneous rocks are produced in the bowels of the earth, but we cannot watch the progress of their formation; and as they are only present to our minds by the aid of reflection, it requires an effort both of the reason and the imagination to appreciate duly their importance.

When first the adamantine masses were squeezed up into form, when rent asunder, is a matter into which we can scarce enter—one which for ever must be bound up with much of conjecture; but *by* what—were it the million hawsers of earthquake, the irresistible crushing of compression, the grooving gouges of the glacier, the sharp teeth of the aqueous file—the passes have been chiselled *can* be studied, investigated, and proved to-day by intelligent inquiry.

Such inquiry, such investigation, such musing with such surroundings, cannot but have a beneficial, an ennobling effect upon us. “Geology,” says Ruskin, “does better in recalling dry bones and revealing lost creations than in tracing veins of lead and beds of iron; astronomy better in opening to us the houses of heaven than in teaching navigation; botany better in displaying structure than in ex-

* The whole British Isles occupy only one-sixteen-hundredth part of the land surface of the globe.

AGE OF THE ALPS

pressing juices; surgery better in investigating organization than in setting limbs. But it is ordained that, for our encouragement, every step we make in the more exalted range of science adds something also to its *practical applicabilities*; that all the great phenomena of Nature, the knowledge of which is desired by the angels only, by us partly, as it reveals to farther vision the being and the glory of Him to whom they rejoice and we live, dispense yet such kind influence and so much of material blessings as to be joyfully felt by all inferior creatures, and to be desired by them with such single desire as the imperfection of their nature may admit; that the strong torrents, which in their own gladness fill the hills with hollow thunders and the wells with winding light, have yet their bounden charge of field to feed and barge to bear; that the fierce flames to which the Alps owe their upheaval and the volcano its terror, temper for us the metal vein and warm the quickening springs; and that for our incitement, I say, not our reward—for knowledge is its own reward—herbs have their healing, stones their preciousness, and stars their times."

Thus speaks Ruskin, and, as we have seen, he denies to the torrent the inceptive fashioning of its own course, seeing in primeval Vulcanian architecture as in contractile contortion evidences of beneficent design of an Almighty hand. "The fact remains always equally plain and equally admirable,

AGE OF THE ALPS

that, whatever the nature and duration of the agencies employed, the earth was so shaped at first as to direct the currents of its rivers in the manner most healthy and convenient for man. The Valley of the Rhone may have been in great part excavated in early times by torrents a thousand times larger than the Rhone, but it could not have been excavated at all unless the mountains had been thrown at first into two chains, by which the torrents were set to work in a given direction. And it is easy to conceive how, under any less beneficent dispositions of their masses of hill, the continents of the earth might either have been covered with enormous lakes, as parts of North America are actually covered, or have become wildernesses of pestiferous marsh or lifeless plains, upon which the water would have dried as it fell, leaving them for great part of the year desert. Such districts do exist, and exist in vastness. The whole earth is not prepared for the habitation of man; only certain small portions are prepared for him, the houses, as it were, of the human race from which they are to look abroad at the rest of the world; not to wonder or complain that it is not all house, but to be grateful for the kindness of the admirable building, in the house itself as compared with the rest."

When we behold the might of these mountain movements, when we witness the terrible avalanche, when we stand afterwards in the "awful solitude,"

THE ENTRANCING AQUEOUS CYCLE

we gain an impression such as that referred to by the poet. Moreover, when we view the majestic, albeit hoary heads of the great summits, we are apt, as does the poet, to regard them as "coeval with the world," and, furthermore, to suppose that they will stand sentinel as they are until the ocean, the universe itself shall disappear. In both these things, however, we know the poet to err. We know that the mountains change, that they are different to-day to what they were yesterday, reckoned by Time's great hour-glass; we know they were not coeval with the world, but that they have been slowly, continuously, laboriously wrought into their present form by the graving tools of Nature etching deeply into their hard sculpture-stone by the weightless mallet of sunshine. We know that those same tools are at work to-day. Only this moment we saw the great dusting-brush of gravity sweep off a mere dust wisp of some hundreds of tons. Of the ice that was thus brushed off some will again find itself on the mountain's crest; for after an entrancing metempsychosis it will pass to water, rush in rivers across the face of the lands, tearing at and destroying their constraining banks, boil and roar in the limitless expanse of ocean, be lifted in invisible vapour by the strong invisible arms of the sun's rays, become visible again in lovely cloudland, be driven by the chill blasts of Æolus against the still colder sides of its mother mountain, fall upon her

LITHIC SCALES

head in flocculent snowflakes, become compressed and congealed into a transient rock, yet again to slip and startle the solitary Alpine traveller.

Much of this we see actually taking place as we stand on elevated spots. Nay, more, we see what is *going* to take place, it may be to-morrow, it may be not until we ourselves are clay, forming part of the earthly mass. Look again up the sheer, harsh face of the Wetterhorn, for example. Is the poet right in saying that it is there to remain until "dying Nature perish in the universal wreck"? Nay, it is shedding scales as does a leper—throwing off successive skins of epidermis as we poor organically-changing mortals do—scales which require not a chemical balance to weigh them but a hundred-ton weighbridge. We see trickling streams of perspiration streaming down across its brow. Every trickle wears off its quota of its surface, gouges out lines upon its face, gives crinkles and crows'-feet, as the years engrave ours with the intaglio of age. The great rocky boulders which fall with the ice-sweat will never again mount to the summit, the vast silt the combining trickles are quietly laying at its feet for lighter ones to walk upon will never again be replaced upon the rocky sides. Universal, useless decay, one might unthinkingly say; not so those leper scales: that cast epidermis is on its way, river-borne, to enrich and renovate soils afar off—soils becoming exhausted in their beneficent efforts

NATURE'S ENGINE

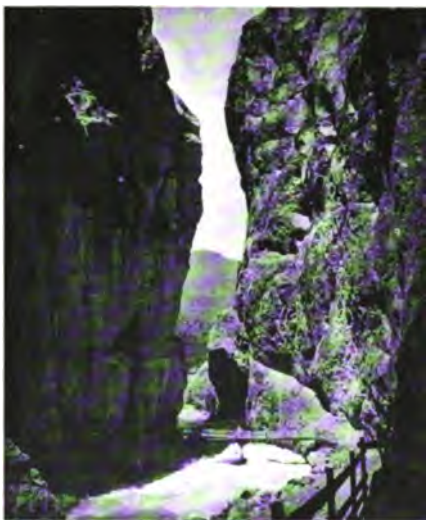
to continuously "bring forth the fruits of the earth."

The vast mass which just came tumbling down the mountain-side was no accident, the great stone-slip before us, the vast heap of sand and detritus which has just been pushed into the stream and gone off, one knows not where—these are no mere accidents; they are functions beautifully, regularly, beneficently performed continuously by the component parts of a million-pieced Titanic engine—a veritable "steam engine," its boiler fed from the "feed-tank" of the great ocean, and "fired" by the universal stoker "Sol" with the most infinitesimal fraction of heat reflected from the great central furnace. Yet the vastness, the inexpressible magnitude of the work this great noiselessly-moving engine is doing no man can either calculate or numerically comprehend. So may we ponder as we stand entranced in the very heart and height of these mysterious Alps, these wrinkled hills in their snowy, cold, gray-haired old age, at first so silent; then, as we keep quiet at their feet, muttering and whispering to us garrulously in broken and dreaming fits, as it were, about their childhood.

When we stand and contemplate such narrow chasms as we see in our photograph, and especially that depicted in the frontispiece to this chapter—with their profound depth, their extreme narrowness, their uneven sides, the raggedness of their

THE EARTHQUAKE AN ARCHITECT

gaping edges—despite the fact that we have beside us the foaming torrent busy at its work, the feeling at once seizes upon us that the glorious fissure was primarily formed by an earthquake. As to why such fractures should have occurred in primeval times we have touched upon, but evidence is not



LV.

wanting that our earth is still contracting, that portions of its crust are still being subjected to intense compression, whilst other parts continue to be put into excessive tension—a tension sometimes greater than the cohesive strength of the earthly material is equal to—and thereby fissures,

clefts, gorges and chasms are still torn open.

“The crushing and folding up of the strata to which mountain chains are due, and of which the Alps afford such marvellous illustrations, necessarily give rise to earthquakes; and the slight shocks so frequent in Switzerland—more than a thousand of such having been recorded during the last century

THE EARTHQUAKE AN ARCHITECT

and a half—appear to indicate that the forces which have raised the Alps are not yet entirely spent, and that slow subterranean movements are still in progress along the flanks of the mountains,” says Lord Avebury, and this is an entrancing confirmation of the speculations anent the original sculpturing.

The science of seismology—like many another—is but in its infancy, albeit recently great progress has been made ; whilst research tends to the supposition that in regard to the Alps, the many shocks to which reference has been made as still taking place may, in a measure, be due to the existence in Switzerland of lakes of great depth.

By the multiplication of seismological observatories the points of origin of the greater earthquakes which send tremors all over the world are now very readily ascertainable, and the Seismological Committee of the British Association was able this year to submit a map to show the neighbourhoods from which the greater earthquakes of the years 1900 and 1901 sprang. The map was drawn up by Professor John Milne, and confirmed in a very graphic way his theory that the major earthquakes arise where great ranges of mountains slope down into great depths of sea. The weight of superincumbent rock in a range of mountains which is two or three or four miles high, and which along a coast-line slopes down to depths of the sea almost as great as

THE EARTHQUAKE AN ARCHITECT

the mountains' height,* may tend, he thinks, to force out the lower strata. The effect of extreme pressure on metals has been shown at the Royal Institution, where iron and steel have been made to flow under pressure like a thick fluid. It is possible that the lower rock strata, with millions of tons of rock over them, sometimes flow in nature in like manner. The earthquake map of the Seismological Committee shows, at any rate, that the greater the slope to the depths of the sea, the greater the number of earthquakes in that region. For instance, off the east of Japan there is a slope 180 miles from crest to base of gradients 130 to 150 feet to the mile. Twenty-nine major earthquakes started therefrom in the two years. In the Javan district, where the irregularities of height and depth are as irregularly distributed as the islands which form their outcrop, there were forty-one earthquakes.

Nature's masons build, but they also destroy. No sooner did they set up these pinnacles of "everlasting" stone than they commenced to pull them down again. Now, we know that those busy masons to which we have already referred, frost and water, are everlastingly sculpturing the mountains, and tending to reduce the height of the chain in two ways—by chipping and rasping at the summits, and

* The ocean used to be considered about as deep at its deepest as the highest mountains are high. It has now been proved to be half as deep again; that is, 46,236 feet.

THE GLACIAL EPOCH

by casting the chips and detritus down into the valleys and thus levelling them up. But the crust of our little earth was destined to know a change antipodean in degree, transcendental in interest ; for, having solidified from a fiery furnace, there came a time in the world's history when, according to the latest scientific theories, owing to a very considerable aberration in the usual orbit of the earth's journey around the sun, it knew an age of lengthy, frigid, ice-inducing winters many months in length, with short summers of about four months to make up its annual journey of many million miles.

During this period, known as the Great Ice Age, the whole of the North of Europe, including the British Isles north of the Thames valley, was covered with a series of immense glaciers, the Continent then presenting much the same aspect as do to-day the confines of the Arctic circle.

The Alps—though the glacier fields of Europe did not quite reach them—were considerably affected by this change in climate ; the line of permanent snow, now stationary at about 8,800 to 9,000 feet above sea-level, sank to about the half of this height, so that all above 5,000 feet, or less than a mile, up the mountains was in the region of eternal snow, and similarly the snow was thicker, the ice more abundant, and the whole more permanent. The summers, however, were warm, and the profuse thawings let loose great raging torrents, which swept, channelled,

INTERGLACIAL PERIODS

and carried away much of the surface of the hills.

Three large ice-sheets then existed in the vicinity of the Alps: the first on the northern slopes, pouring its water towards the basins of the German rivers; a second covering most of Switzerland, Savoy, and Dauphiny, sending its waters to the Valley of the Rhone; and the third resting upon the Italian slopes, destined to feed the Valley of the Po and the beauteous Northern lakes of Lombardy.

Then our world knew a period of more temperate, more kindly climatic degree, for this glacial period was followed by an interglacial one, to give place to a second Ice Age, this resolving—and dissolving—into the climatic conditions we have now.

The interglacial period was also very similar in its climate to ours of the present day, and it was during this time that the immense glaciers formed in the colder period were melted and loosened. Then were Dame Nature's masons put busily to work, and their sculptures of that date are extant to-day. The immense masses of moving matter they set free not only grooved and eroded, but transplanted huge boulders, many of them, twenty, thirty, fifty tons in weight, being, as we see, deposited on the plains far from the place where they were first formed,* or else left hanging in some inaccessible spot, where every moment they look as if about to

* See Rhone Valley, "Fragments of Continental Journeyings."

INTERGLACIAL PERIODS

fall and overwhelm us. Even to-day we may trace the descent of these glaciers, as, for example, in the Grimsel Pass referred to, by their gougings, groovings, and scorings, tracing out with hitherto indelible engraving the course they followed on leaving their mountain homes.

Nay, more; they have cut out gorges for themselves through the solid mountain, divided enormous peaks in twain, planed down and levelled great asperities. The vast streams of water liberated from them continued their work, gouging out and cutting down their original beds by hundreds of feet. They have scooped out the lake basins; they have determined the flow of such rivers as the Rhine, the Rhone, and the Po; they have reduced the heights, exalted the valleys, and hammered, chipped, chiselled, and planed until the Alps, as we see them to-day, no longer bear resemblance to the Alps as they were first formed.

These two periods of glaciation—some contend there were three—followed by periods of melting and shifting of the ice-fields so formed, have done more to carve off and lower the height of the mountains than many centuries of the conditions obtaining to-day could effect or the work of rivers and torrents accomplish, and thus these few remarks may serve somewhat as a reply to Ruskin's exclamation, "When did the great spirit of the river first knock at these adamantine gates?"

ALL AROUND US CHANGETH

Surely in no country are these entrancing evidences of Nature's masonic work more continually, more beautifully, more romantically brought to one's observation than here in Switzerland, these carvings, these engravings, these writings on the wall, presenting themselves to us in every pass, on every summit, in every valley. Verily all around us changeth and decayeth ! and the conviction is potently forced upon us that it is only a matter of time when the Alps will not be, neither will the *thals* ; for the mountains will be planed down by erosion and disintegration, whilst the valleys will be raised and choked with the chip-pings and scalings. " But it will require ages upon ages ! " you may exclaim. Even so ; but, nevertheless, those ages will be but as the falling of a few grains of sand in the hour-glass of time. Indeed, had the Alps been as old as the mountains of middle Germany they would long ere this have ceased to exist.

Truly, how puny is man ! How insignificant his midget work compared to these mighty labours of Dame Nature's masons ! Work which goes forward, irretrievably, irresistibly, incessantly, by day and by night, making and breaking, building and razing, till earth shall have accomplished her doom !

From the foregoing it will be seen that the most potent of Nature's masons is water. Water is indeed her chisel—her incisive, all-graving, unwear-ing chisel—whilst gravity is her mallet.

To bring the vast power of this invisibly-wielded

GRAINS IN THE HOUR-GLASS

masonic mallet home to our very selves, we have but to oppose our own strength to its hammerings when in vigorous work—as in the mountain fall—full well we know one single blow would be our annihilation. E'en to try to stem the current of a river—of but moderate speed—to pit our puny strength against its most gently-delivered tapping, suffices to teach us of its power.

But if water be the chisel, and gravity the mallet, who is it that deals the blows? Reflecting, we cast our eyes up to the clear blue sky, across which are sailing Alpwards exquisite gossamer flecks and fleeces, down-like clouds, light and flocculent. Surely they will kiss the mountains' brow with touch "lighter than infant's breath"! Surely *they* can deal no blows, wield no mallet!

Strange indeed it seems that those gently gliding aerial veils and mists, too *légère* to fall, are in very truth Dame Nature's beauteous masons, her most sturdy labourers; indeed, perhaps we ought to say her *only* masons. For chose they to migrate, to sever companionship with Mother Earth, *all* carving would henceforth cease. At this very moment, as they glide o'erhead in silent splendour, their arms are uplifted; they are bent upon striking a blow here close beside us, and ere another hour has fled they will have scored and chipped at Nature's face, and ere the morning the scrapings and chips will lie at our feet down here in the valley.

AERIAL MASONS

“Has the reader any distinct idea of what clouds are?” asks Ruskin. “That mist which lies in the morning so softly in the valley, level and white, through which the tops of the trees rise as if through an inundation—why is *it* so heavy, and why does it lie so low, being yet so thin and frail that it will melt away utterly into splendour of morning when the sun has shone on it but a few moments more? Those colossal pyramids, huge and firm, with outlines as of rocks, and strength to bear the beating of the high sun full on their fiery flanks—why are *they* so light, their bases high over our heads, high over the heads of Alps? Why will these melt away, not as the sun *rises*, but as he *descends*, and leave the stars of twilight clear; while the valley vapour gains again upon the earth, like a shroud? Or that ghost of a cloud, which steals by yonder clump of pines; nay, which does *not* steal by them, but haunts them, wreathing yet round them, and yet,—and yet,—slowly; now falling in a fair waved line like a woman’s veil; now fading, now gone; we look away for an instant, and look back, and it is again there. What has it to do with that clump of pines, that it broods by them, and weaves itself among their branches, to and fro? Has it hidden a cloudy treasure among the moss at their roots, which it watches thus? Or has some strong enchanter charmed it into fond returning, or bound it fast within those bars of bough? And yonder filmy

LEVIATHANS OF CLOUD

crescent, bent like an archer's bow above the snowy summit, the highest of all the hills—that white arch which never forms but over the supreme crest—how is it stayed there, repelled apparently from the snow,—nowhere touching it, the clear sky seen between it and the mountain edge, yet never leaving it—poised as a white bird hovers over its nest? Or those war clouds that gather on the horizon, dragon-crested, tongued with fire,—how is their barbed strength bridled? What bits are those they are champing with their vaporous lips, flinging off flakes of foam? Leagued leviathans of the Sea of Heaven,—out of their nostrils goeth smoke, and their eyes are like the eyelids of the morning; the sword of him that layeth at them cannot hold the spear, the dart, nor the habergeon. Where ride the captains of their armies? Where are set the measures of their march? Fierce murmurers, answering each other from morning until evening—what rebuke is this which has awed them into peace:—what hand has reined them back by the way in which they came?

“I know not if the reader will think at first that questions like these are easily answered. So far from it, I rather believe that some of the mysteries of the clouds never will be understood by us at all. ‘Knowest thou the balancings of the clouds?’ Is the answer ever to be one of pride? ‘The wondrous works of Him which is perfect in knowledge?’ Is *our* knowledge ever to be so?”

THE BALANCINGS OF THE CLOUDS

Clouds are equally interesting and beautiful whether they be in motion or at rest. Physically, a cloud is never quiescent. Some portion of it is always coming into being, other portions disappearing into invisible aqueous vapour. A very beautiful exemplification of this is to be seen among the



LVI.

Alps, for there we sometimes have the good fortune to see great “streamers,” or cloud flags—such as we illustrate—streaming away for thousands of feet from the summit of snow-capped mountains; and when they present themselves at sunset—or, better still, *after* sunset—to us in the valleys, the effect is

THE BALANCINGS OF THE CLOUDS

magnificent, for then these imposing streamers appear to be vast tongues of fire blown aside from a glowing volcanic crater debouching at the mountain's summit.

We often hear the question asked, "Why does it not detach itself and float away?" The answer is that it is for ever detaching itself, its pennon point is for ever dissolving into nothingness, its end in contact with the cold mountain is for ever coming into being. The physical reason is simple, but a little surprising, when we say bluntly that there is just as much cloud in front of the mountain—though we cannot see it—as there is in the streamer we are admiring. For there are just as many tons of water there—held invisibly—as the cloud we see holds, visibly; but the atmosphere on the windward side of the mountain, being warmer, is able to support its burthen without condensing it to visibility, whereas directly it has been driven into contact with the cold summit its temperature is so much reduced that the aqueous vapour becomes mist—beauteous cloud streaming away as if it were trying to tear itself from the chill mountain grasp and float to warmer climes. But, alas for its arrogance! its own point is already in warmer clime, and the clear atmosphere demands and retakes the evanescent vision to itself, folding it again within its etheric meshes lightly and—invisibly.*

* A similar effect is conversely presented by the stream of steam leaving the chimney of a locomotive. In winter the

CLOUD FLAGS

These beautiful flag-clouds the casual observer would call stationary clouds, and certainly they are very beautiful, far more beautiful here among the Alps than when simply suspended, to give grateful shade, above the lowlands. They have a predilection for certain districts, for which reasons can always be ascribed, and we illustrate a cloud effect often to be seen in looking up the *Zermatthal* to the acute *Matterhorn*.

Contrast, again, the valley mist with that of the mountain. On a November morning we are walking over some moderately lofty knoll rising above the flat bottom of a valley enclosed within an arena of mountains. There we see around us what at first appears to be a sea of most beautiful gray-blue. We think we can see nothing else. Let us peer more searchingly, however, into the shallow depth of this drab-azure expanse. We now find we are able to see through it as through a tulle of smallest mesh, a fairy gossamer, a veil of morning spread over the still sleeping villages; for, now that we

clouds of steam flaunted by the metallic steel are voluminous indeed, in summer they are often quite invisible, but in a mean temperature the point to attract our attention is that there always exists a well-defined space between the top of the funnel and the commencement of the cloud of steam. Yet we know there must be as much water there as in the brilliantly white cloud itself. We have given the explanation in regard to the mountain, and the space we here refer to will be greater or less according to the atmospheric conditions of temperature and humidity.

"RISING" MISTS

have properly focussed our eyes, we see as if they were in a lake of blue waters the spire of the village church, with its bright oak shingles, the whitewashed walls of the pigmy homestead, the gray streaks of roads joining the townlets.



LVII.

As we watch, we see that some portions of the flat valley bottom are now much more clearly discernible than other parts. "The mist is rising," we should be told. It is certainly moving. We feel a cool breath of air fanning the hillside; we see the blue mist becoming whiter and driving leisurely up towards us. Here it comes, covering the Alp with a

"RISING" MISTS

shallow covering—not many yards thick—of flocculent, wreathing steam, just as we see it in the illustration, the white line in the foreground being the snow of our mountain summit.



LVIII.

"The clouds move upwards! as on ocean
Move the long billows. With a ceaseless motion
The white mists follow, far below ;

Wan as dim visions in a glass,
With furtive, stealthy steps and slow,
From dusky slope to slope they pass,
Swathing the sombre mountain-flanks,
Filling the leafless glens forlorn,
Shrouding the melancholy ranks
Of gaunt, green pines, until these seem
Like ghostly figures in a dream."*

What a wondrous contrast we have between these diaphanous, tulle-like draperies of the atmosphere and the heavy, tumbling, seething billows of the hurrying storm-cloud. All suddenly amid the mountains on they come, rushing onwards, casting summer sun into winter gloom, throwing their white mantle-folds around us, catching us, as it were, in a gladiatorial net, blindfolding us and

* W. Sharp.

UPBEATING CLOUD

enchaining us to the mountain-side almost helpless.
Yet what a glorious sight when we stand, and from
afar watch,

“ Amid an amphitheatre of hills,
Vapour-winged, the sudden tempest springing ;
From steep to steep ascending, the gay train
Of fogs, thick-rolled into romantic shapes ;
The flitting cloud against the summit dashed
And by the sun illumined.”

Indeed, it is far more pleasant to view these
fitful cloud angers from afar, than to be swathed
within them. We remember once, in crossing the
Simplon in winter, leaving *Iselle* (the frontier on
the Italian side) at daybreak, in a drizzling rain,
when all was misty, gray, and cheerless ; as we
journeyed upwards, trundling our cycle up the
steep zigzags, we were pleased at about 1,000 feet
to emerge into sunshine. We looked back, but
there was no fair Italia. She was there in tears
'neath a heavy pall. All around us the rocks were
steaming off their recently-deposited mist-damp,
and so were our clothes. We congratulated our-
selves that the sun was bearing us company into this
dark and sombre, awe-inspiring pass of *Gonda*,
when, on again looking back, we saw that the edge
of the mist nearest us was being torn away from
the mass and drifting towards us. Up it came with
extraordinary swiftness, borne on a cutting blast,
which whistled among the asperous and creviced

ENWRAPPED IN CLOUD

head-rocks, and at once we found ourselves immersed in a tumultuous sea of clouds. These rushed forward, wreathed and seethed, tossed upwards into thin edges like sea-spray, rolling, and sometimes gyrating in little local whirlwinds, all in a manner words are powerless to convey. Then came thunder.* Then did the lightning's electricity cohere the clouds into such rain as our own land never feels—a rain which drenched us to the skin in far less time than it takes to write this.† Well indeed do we

* Although ordinary clouds float at from one to two miles above the earth, heavy thunder-clouds are usually not more than half a mile from the earth's surface.

† There can be little doubt the distinctive density and definition of outline of thunder-clouds is due to an attraction or increase of cohesion between the raindrops. This can be shown experimentally, for if whilst steam—as, for example, from a boiling kettle—is issuing from an orifice the air of the room be slightly electrified by the simple rubbing of a glass rod, it is noticeable that the steam cloud becomes both whiter and denser, which looks blacker if the sun be behind it, but whiter if the light fall upon it. A similar verification may be made by electrifying the air in the neighbourhood of a fountain, when it will be found that the spray coalesces into heavy drops, reminding us at once of “thunder rain.” This increase of cohesion of particles, brought about by electrical influence from great distance, is at the root of success in wireless telegraphy; whilst recent research in electrophysiology has shown similar action takes place in the matter of the brain, which coheres, becoming more dense when electrified by inductive influence from the distant thunder-cloud, and hence may be explained the distressing depression and lassitude experienced by many during thunderstorms.

WEIGHT OF THE CLOUDS

remember having to beat our clothing, frozen stiff next morning, into some semblance of suppleness before we could force ourselves into it. Well do we remember taking leave of the holy Father at the hospice betimes in the morning with very few buttons buttoned, and then—a Brother having tied an old ladder behind our machine to act as brake—we scudded merrily down the zigzags until we thawed.* And then the misery of the tripe-like clinging! Yet when we arrived at *Berisal*—first stage up from the Rhone Valley—we were not only glowing with warmth, but our clothes were dry, whereas a fellow-countryman in the *coupé* of the up diligence-sledge, in fur coat and gloves, whilst expressing his surprise to see the ladder in tow, told us he was bitterly cold. We could now button up, and this we did over a hearty breakfast.

To appreciate the enormous work done by the clouds we have only to contemplate the glorious snow-caps upon the mountain summits. These vast expanses of untrodden snow represent the thousand upon thousand ton cargoes once stored in the beauteous, flocculently-packed holds of the resplendent cloud leviathans—cargoes which have been removed by invisible stevedores noiselessly and without rattle of chain or puffing of crane; discharged, indeed, with a dexterity beauteous as wondrous, and laid down upon the mountain's brow in soft silence

* See illustration No. 1.

POWER WITHIN THE CLOUDS

and with tenderness, such as only loving hands could evince in spreading the snow-like coverlet o'er the cold blanched brow of a dear one passing hence.

Ofttimes, when afar on high, as we gaze across the ocean of rugged summits, we see one or more of them gradually obscured from our view, as a phantasmagoric picture dissolves from the screen before us, and we know that the Æolian stevedores are throwing out a snowy burthen which descends upon the chain soft as swan's-down; yet, if later on we clamber upon the snow-spread summit, we shall find that the frigid coverlet is quite unlike the snow we are wont to crunch beneath our feet on our own islands.

Whilst watching the *légère* and flocculent snow-flakes descending upon the land—so gently, so softly, so silently, sometimes even stopping to whirl and wreath upward, to dodge and dance and float in fairylike, fantastic gyrations, the very emblem of aerial lightness and fragile, gossamer-like structure—one is unlikely to reflect that they in reality were fashioned by arduous elemental toil, that in invisible occultation they enfold within their frigid floral texture a marvellous energy, an incomprehensible amount of latent force. Yet such is the fact; the gentle snowstorm is the carrier of giant horse-power.

“I have seen,” says Tyndall, “the wild stone-avalanches of the Alps, which smoke and thunder down the declivities with a vehemence almost sufficient to stun the observer. I have also seen snow-

POWER WITHIN THE CLOUDS

flakes descending so softly as not to hurt the fragile spangles of which they were composed ; yet to produce from aqueous vapour a quantity which a child could carry of that tender material demands an exertion of energy competent to gather up the shattered blocks of the largest stone-avalanche I have ever seen and pitch them to twice the height from whence they fell."

Yet their birth is instantaneous,* their whole life and death a matter of minutes. But in their short life what vast burthens do they carry and deposit here as " eternal snow " upon the mountain crests !

We spoke of thousand-ton cargoes: we had better say millions of tons. Indeed, Monsieur Rendu has computed that in a single century the volume of snow falling upon the Alps would suffice to increase the height of the whole chain by no less than four hundred feet. But the mountains do not increase in height, a circumstance upon which we dwell a little later on.

We have mentioned elsewhere that were there no

* As a curious exemplification of the instantaneous formation of snow, we may mention that in Russia, if towards the end of a lengthy dance, when the hot air of the ball-room has become well charged with moisture from the lungs, the intensely cold outer air be admitted, snow will at once form and fall upon the floor. Bearing also upon this we recall the experience of Arctic explorers and the remark of Mr. H. De Windt, " When we breathed our breath froze and fell on the ground in the form of powder."

DUST AND CLOUD FORMATION

dust in our atmosphere there could be no sky ; we might have gone farther and said neither could there be clouds, for it has been shown that upon the aqueous vapour losing its gaseous form and becoming condensed into minute specks of water, this condensation always takes place round a nucleus or small particle of dust.*

The most wonderful and surprising demonstrations of cloud formation, however, are when, on perfectly quiescent days or nights, huge volumes of mist accumulate in the valleys, and whilst converting these into great lakes of cloud, yet leave the mountain summits quite clear and open to the golden rays of the sun or the silver rays of the moon.

The casual visitor to Switzerland is not likely to

* The Rev. J. M. Bacon, who has been investigating the matter of the air over London, says : " With regard to dust in suspension over the town, my observations go to show that in calm weather this will hang at certain levels in strata, or, as I am led to believe, not infrequently in definite clouds, which yield to the influence of a breeze, which are higher in dry and lower in moist weather, and which are largely washed out of the air by summer showers. I have often found that at some height, generally about 6,000 feet, it is possible to surmount the haze and look down on its surface as though the grosser matter in suspension had a definite upper limit. Above this limit the day sky wears a darker blue, and at night the stars redouble their splendour." We may add that Mr. Bacon has kindly endeavoured to procure interesting photographs that we might present them to our readers ; climatic conditions have, however, prevented him.

A SEA OF SWAN'S DOWN

see these beautiful phenomena in their wildest mood, because they are only caught thus during winter. Yet, on a small scale, he may be fortunate enough to see them from time to time.

Winter visitors to *Montreux* who ascend to *Caux*, and especially the more energetic who get up as far as the summit of the *Rochers de Naye*, are sometimes rewarded with the sight, and thus become acquainted with the phenomenon, coming down full of the scene to describe their impressions to their friends—actually submerged—in that same sea.

Some say it is like tulle or gauze, for sometimes one can just discern objects through it—pastures, steeples, *châlets* ; others say it is like curdled cream, for it is varying in opaqueness ; whilst others liken it to the Arctic Sea.

We have never been to the latter inconveniently get-at-able place, and cannot say what it may be like ; but that the upper surface of these mist lakes is exactly like a white sea we *can* say, and to our mind it would be precisely represented by either a sea of cotton-wool or an ocean of swan's down.

The finest demonstration of the phenomenon we ever saw was from the summit of the *Grand Chasseron*. It was in winter, and all the valleys of Northern Switzerland had been full of a very dense mist for nearly a week. We had ascended to *St. Croix* without seeing anything whatever of the lake of *Neuchâtel* we were leaving behind us, and, indeed,

MIST IN THE WOODS

of anything of our surroundings beyond the phantom forms of the forest pines, their straight trunks reeking with the condensed mist, their myriad sharp spires each carrying a tiny globule of the water of condensation.

Up, up we went, demonstrating to our panting selves that this great sea of mist was at least 3,000 feet in depth, when, having nearly reached the mountain watchmaking *dorf*, we become conscious that the gloom of the mist—which in itself was white—was assuming a decidedly *bluish* tinge. As we rose the depth of tint increased, until all around us was illuminated with a blue light, quite as vivid as that used in the production of demon scenes upon the stage. Then the amount of light increased—the blue remaining—and we appreciated that we were about to emerge from the top layer, so to speak, of this mist sea. Another half an hour, and we saw the sun, emerged upon a fresh Alp, and discerned the *châlets* of the sleepily-industrial Holy Cross.

We had started in early morning, and had spent several most interesting hours with M. Mermod, himself a member of the Swiss Alpine Club, in studying the mountain manufacture of watches and musical boxes, when our courteous host informed us that he had a guide in readiness to conduct us to the top of the *Grand Chasseron* to see the sunset and *alpenglow*—one of the most praised in Switzerland

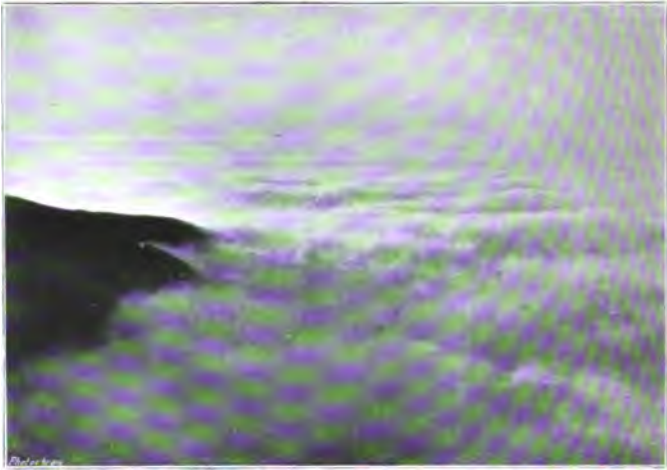
GRAND CHASSERON

—and that there was no time to be lost, for although he could if he desired lengthen the time of the running of his engine for us, yet he could not lengthen the day or delay either the diurnal *coucher* of the sun or the “after-glow” over the Bernese Alps we were so anxious to witness. Taking leave of him, therefore, we hurried upwards, which enabled us to make a practical comparison of the efficiency of Switzer mountain-climbing lungs and *quasi*-sedentary English ones. The valley, still enveloped in its steamy mist, had already been some time in shadow, and now St. Croix had seen Sol’s cheery face for the last time that evening. The pointed top of the Great Chasseron was, however, still in a golden glory, and it was obviously necessary that we should pass out of the twilight, and catch up to and enter this yellow zone. This at length we did, to see again the sun’s now enlarging disc, which in less than thirty minutes was to sink behind the Bernese *Oberland* in blood-red splendour.

The view from the top of the *Chasseron* is certainly very fine, and well repays us for our two and a half hours’ climb to his summit (5,285 feet). Arrived here, we looked down upon a mist sea at least 80 kilometres wide and nearly 300 long, a veritable ocean 50 miles wide by 150 miles, or thereabouts, in length. An ocean, albeit not in vigorous motion, yet neither calm nor quiescent as

A MIST OCEAN

to its surface, for it is moulded into the most beautiful of softly-contoured waves and gently-heaving billows, whiter than the whitest glacier, more kindly than those icy seas of brusque undulation and profound *crevasse*. Pine-covered summits, of lower altitude, look exactly like dark islets rising



LIX.

sharply from the waves, whilst the larch-clad side of the *Mont des Baulmes* runs down into the pure and glorious expanse, precisely like a tapering peninsula, and not unlike a great black-backed whale rising from it.

Down into the valley this ocean would have a depth of at least 1,000 metres, and there it looks as opaque as opaque is, but near our feet on the shelving foreshore—as we may say it is—thins out

A MIST OCEAN

till it has exactly the appearance of spray flying high and falling softly back upon the forest of firs.

So perfect was the illusion that this was a sea of something far more substantial than mist, that it was difficult to realize, as we stood on the shores of



LX.

this Arctic ocean, that in one short hour it could be dissipated and vanish like those snow-like clouds o'erhead.

“Lo ! like the foam of wintry ocean
The clouds beneath my feet are curled ;
Dividing now with solemn motion,
They give me back the world.”*

* Aubrey de Vere.

THE ALPENGLOW

There was but one thing which obtruded upon the perfect illusion—the pointed steeple of *St. Croix*, which peeped up like a pointed *buoy* just above the woolly billows. Whether we looked towards the Alsatian valleys, those of the French *Doubs*, or towards the Swiss *Oberland*, it was all the same—these beauteous *vals* were now beautiful seas.

To-day we see only the higher summits; but the summer* visitor sees the *Plateau Vaudois* (*Canton de Vaud*), the lake of *Neuchâtel* stretching away to left and right, where at its end is *Yverdon*, whilst to the left is the town of *Neuchâtel*. To the right, again, rise the mountains of *Haute Savoie*, *Geneva* being hidden by the *Suchet*, which we see rising above the *Mont de Baulmes*. The highest mountains opposite to us are those of the *Mont Blanc* chain; to the left the *Tour Sallières* and the *Dents du Midi*, the *Dents de Morcles* and the *Rocher de Naye*, whilst those in front, of lesser altitude, are the *Fribourgeoises Alps*, the *Alps-Brunoise*, and the *Alps-Glavonnaises*. Behind us we look down upon *la belle France*, in which *Besançon*, the centre of horological industry, is discernible. As for the land upon which we stand, it is moorland, and reminds us of the black acres around *Ilkley* in *Yorkshire*, and this but heightens the contrast between the white misty sea and the dark stern headlands.

* We returned to see the view again in summer.

THE ALPENGLOW

But whilst our guide has been pointing out all these things, the sun has sunk to rest behind the apparently limitless *Bernese Oberland*. To try and paint its effect in words were futile. We will not attempt it; merely will we mention that this evening—"in this hour of softened splendour"—its beauty is enhanced by the ever-changing tints continuously yet evanescently reflected from the ravishing sea of mist below as well as from the sky above. And now, whilst we ourselves are in shade, we are cheered, astonished, stupefied, by the beauty of the alpenglow, which in no part of Switzerland is more beautiful than yonder, above the *Bernese Alps*, and can from no position be more advantageously seen than from the summit of this *Great Chasseron*.

"'Twas at this instant—while there glowed
This last, intensest gleam of light--
Suddenly, through the opening road,
The valley burst upon my sight!
That glorious valley, with its lake,
And *Alps* on *Alps* in clusters swelling,
Mighty and pure, and fit to make
The ramparts of a Godhead's dwelling!

"I stood entranced and mute – as they
Of Israel think the assembled world
Will stand upon that awful day,
When the Ark's Light, aloft unfurled,
Among the opening clouds shall shine,
Divinity's own radiant sign!

THE WORLDLY MIST

“Mighty *Mont Blanc* ! thou wert to me,
That minute, with thy brow in heaven,
As sure a sign of Deity
As e’er to mortal gaze was given.
Nor ever, were I destined yet
To live my life twice o’er again,
Can I the deep-felt awe forget—
The ecstasy that thrilled me then !

“No—never shall I lose the trace
Of what I’ve felt in this bright place.
And should my spirit’s hope grow weak,
Should I, O God, e’er doubt Thy power,
This mighty scene again I’ll seek,
At the same calm and glowing hour,
And here, at the sublimest shrine
That Nature ever reared to Thee,
Rekindle all that hope divine,
And *feel* my immortality !”*

“God help those buried in the depths of that great misty ocean, asphyxiated 3,000 feet beneath us, drowned, as it were, in fog-heaped depths !” was the thought which involuntarily escaped us ; and we pondered, “Is it not typical of men’s lives elsewhere ?” The brightness of the world is hidden from them by a pall of fog and smoke. They have their being in their shops and offices ; they rise from their beds to take a hurried breakfast, push through sulphur-laden human burrows to ill-lit, ill-ventilated offices, returning again at night without ever once having

* Thomas Moore.

NATURE'S EFFORTS TO PLEASE

seen the glorious sky. They pit their lives to earn a competency only to be stolen from them by death. Most of them, indeed, make no effort to rise above the fog of mediocrity, the stagnant mists of sameness, never to see, to enjoy, nor to be illumined by knowledge and understanding of even their own world.

Even after the sun's welcome face had disappeared, leaving behind a certain inexpressible feeling of loneliness, relieved, however, by the vivid sky illumination, like the reflection from the gaping *embouchure* of a blazing volcano, the beauty of the scene was such as to be inexpressible in words. The light disappeared, and as quickly as the alpenglow faded—as quickly, as it seemed—the brilliant moon gained in power. It seemed at first to fight a battle with the lingering alpenglow. The invader marshalled her forces of steel grays and sent them forth in aggressive array against the red and gold-edged battalions of the retreating sunrays, and this across a gorgeous plain of deepest azure, itself changing rapidly into steely blue.

“ But for an hour we see the Alpen glow
Tinge rosy red the pathless fields of snow !
We see it spread across the mountain's breast
From cliff to cliff, till on some lofty crest
It kindles one lone light of crimson ray,
And softly dies, the last, last fire of day !”

Half running, half sliding, over the steep and soft

HUMAN NATURE'S DAILY FOOD

turf, steering our descent with our alpenstocks *en arrière*, we were down in the village in less than a third of the time it had taken us to ascend, charmed indeed with what we had seen.

It has been pointed out by Ruskin as strange how little in general people know about the sky.

"It is the part of creation," says he, "in which Nature has done more for the sake of pleasing man, more for the sole and evident purpose of talking to him, and teaching him, than in any other of her works ; and it is just the part in which we least attend to her. There are not many of her other works in which some more material or essential purpose than the mere pleasing of man is not answered by every part of their organization ; but every essential purpose of the sky might, so far as we know, be answered if once in three days or thereabouts a great, ugly, black rain-cloud were brought up over the blue, and everything well watered, and so all left blue again till next time, with perhaps a film of morning and evening mist for dew ;—and instead of this, there is not a moment of any day of our lives when Nature is not producing scene after scene, picture after picture, glory after glory, and working still upon such exquisite and constant principles of the most perfect beauty, that it is quite certain it is all done for us, and intended for our perpetual pleasure. And every man, wherever placed, however far from other sources of

THE MUTATIONS OF OUR CANOPY

interest or of beauty, has this doing for him constantly. The noblest scenes of the earth can be seen and known but by few ; it is not intended that man should live always in the midst of them ; he injures them by his presence, he ceases to feel them if he is always with them ; but the sky is for all : bright as it is, it is not

“ ‘ too bright nor good
For human nature’s daily food ;”

it is fitted in all its functions for the perpetual comfort and exalting of the heart,—for soothing it, and purifying it from its dross and dust. Sometimes gentle, sometimes capricious, sometimes awful—never the same for two moments together ; almost human in its passions, almost spiritual in its tenderness, almost divine in its infinity, its appeal to what is immortal in us is as distinct as its ministry of chastisement or of blessing to what is mortal is essential. And yet we never attend to it, we never make it a subject of thought, but as it has to do with our animal sensations ; we look upon all by which it speaks to us more clearly than to brutes, upon all which bears witness to the intentions of the Supreme that we are to receive more from the covering vault than the light and the dew which we share with the weed and the worm, as only a succession of meaningless and monotonous accident, too common and too vain to be worthy of a moment

FOR THE SAKE OF PLEASING

of watchfulness, or a glance of admiration. If in our moments of utter idleness and insipidity we turn to the sky as a last resource, which of its phenomena do we speak of? One says it has been wet; and another, it has been windy; and another, it has been warm. Who among the whole chattering crowd can tell one of the forms and the precipices of the chain of tall white mountains that girded the horizon at noon yesterday? Who saw the narrow sunbeam that came out of the south, and smote upon their summits until they melted and mouldered away in a dust of blue rain? Who saw the dance of the dead clouds when the sunlight left them last night, and the west wind blew them before it like withered leaves? All has passed unregretted as unseen; or if the apathy be ever shaken off even for an instant, it is only by what is gross, or what is extraordinary. And yet it is not in the broad and fierce manifestations of the elemental energies, not in the clash of the hail nor the drift of the whirlwind, that the highest characters of the sublime are developed. God is not in the earthquake, nor in the fire, but in the still, small voice. They are but the blunt and the low faculties of our nature, which can only be addressed through lamp-black and lightning. It is in quiet and subdued passages of unobtrusive majesty, the deep and the calm, and the perpetual; that which must be sought ere it is seen, and loved ere it is understood; things

HORSE-POWER IN THE CLOUDS

which the angels work out for us daily, and yet vary eternally; which are never wanting, and never repeated; which are to be found always, yet each found but once;—it is through these that the lesson of devotion is chiefly taught, and the blessing of beauty given.”

We are not quite in agreement with Ruskin when he says—in his picturesque language—that “it is the part of creation in which Nature has done more for the *sake of pleasing* man;” but we are entirely in accord with him when he continues, “more for the sole and evident purpose of talking to him and *teaching* him than any other of her works.” For the engineer is unable to look upon clouds merely as things of beauty, since he knows them to be very hard workers. He sees a long and beauteous bank of cloud sailing across above the horizon; he knows that that handsome broadside belongs to a ship of hundreds, perhaps thousands, of horse-power; whilst we all know that it may contain sufficient stored-up electrical energy to annihilate with a single one of its flashes erections put up by the arduous labour of man. But all do not appreciate what a large amount of horse-power the sun has spent upon that one cloud which looks so light and flocculent. It has cost him the work-worth of a hundred thousand horses, but his efforts have not been wasted. True to its trust, that cloud, when called upon, will return every one of those many horse-power it has

WHO DRIVES THE TIC-TAC MILL ?

at this moment enwrapped within its golden bulwarks.

When you were sojourning in *Geneva*, were not you transported from place to place in electric trams? But did you stop to think who drove them? It was the clouds! Who fatiguelessly lifts the tourist in electric cars to the top of the mountain? The clouds! If you weigh thirteen stones, some kindly-disposed cloud will have borrowed from old Sol thirteen stones, and more—for he charges a little for wastage; he will have credited the sun with that amount for lifting him out of the sea or some neighbouring forest, and that amount he will pass to your account, tourist; his banker—the mountain stream—will drop those thirteen stones into a water turbine there far down in the valley, and, lo! you find yourself climbing the mountain-side, comfortably ensconced in a luxurious car! You are grateful, and wish to thank somebody. Do so; thank the engineer, but do not forget the clouds.

At the commencement of our remarks upon the clouds we referred to cloud streamers, or pennons, and explained their formation, and how at sunset they appear as tongues of fire. There is another abnormal demonstration in cloudland amid the Alps prepollent to transfix us with astonishment. For it sometimes happens that smoke or steam in vast volume appears to be emitted at the mountain

STEAM AMID THE SNOWS

summit, and goes rolling, seething, and drifting away far out o'er the ocean of crests.

This is a rarer phenomenon, and requires a different explanation. It is seen in beautiful fidelity in our photograph. The vast white volumes, seemingly of smoke, we see rolling away in billowy opacity from the mountain summit, as if a hundred



LXI.

bonfires were lighted just beyond the crest, are, like the clouds from the bonfire, in reality steam, and thus produced. To the left of the mountain and behind it there are copious currents of air ascending from the warmer valleys. This air is saturated with moisture, yet quite transparent and invisible. As it ascends towards the summits it of course

STEAM AMID THE SNOWS

expands, and hence its temperature experiences a considerable fall, accentuated by its arrival amid the snowfields. Arrived at a level with the summit of the snow-capped mountain, it encounters the icy blast sweeping over and around it, whereupon the invisibly suspended aqueous vapour of these up-rising currents is instantaneously condensed into dense steam, and rolled away from the summit by that same cold breeze so importantly involved in the formation of the exquisitely dense and brightly illumined cloud we see heaving its vast billowy form aloft, as it were, from a boiling lake or ebulliating cauldron high up amid the mountain snows.

The explorer in unknown seas shouts with joy when he sees looming above the horizon—what? A cloud no bigger than a man's hand. And why? Because he knows that there is an island there. He knows more: he knows that on that island, which he has never seen, there is a forest. Now, physically a forest is nothing more nor less than a gigantic pump, and old Sol is always at work upon its leaves as soon as his rays reach them. He pulls at those leaves just as we do at our cigars.* By them he pulls the water out of the earth, and gives it—nay, lends it only—to his beauteous clouds.

* There are, however, forests of leafless trees in some parts of Australia. They respire, so to speak, through a little stem, apparently answering the purpose of a leaf. The tree is known as "the leafless acacia."

WHO DRIVES THE TIC-TAC MILL?

We continue our stroll along the valley, and hear a drowsy "tic-tac." It is the primitive water-mill of the mountain woodman. There it trundles, obedient to his wish. But who brought him this well-disposed power? The clouds—the angels of the ocean, the Dryads of the woods. These were the messengers; these were the willing workers. The great angel of lake and sea, rain; the soft phantom Dryads of wood and forest, mists. To him was sent a special messenger upon a special errand — the coming and going of the intermittent cloud.



LXII.

These are the messengers, the good genii, who control the aspect of the country, the verdure of the valleys, the barrenness of the summits; these are they who form the thundering cataract or drive the humble saw-mill.

Here "in the mossland" beneath the dark pines they are obediently dragging round the sawyer's timber tympanum, creaking and toiling and earning his dinner for him, just as did the obedient bullock in the "whims" of days gone by. Thus, the creak-

THE VOICE OF SILENT SUNBEAMS

ing of the little timber-wheel here and the loud roarings of the thunders of Niagara are but the *voice* of the *silent* sunbeams.

These are they that lift the million-ton waters from the ocean and from the outspread arms of the great forests, noiselessly, without commotion or straining, nor with visible exertion, to the mountain summits, Herculean task, performed sometimes on the wings of an invisible Mercury, sometimes in the chariot of soft swan's-down mist, to which Zephyr has harnessed some of her thousand horses—proud, invisible steeds who sometimes drag the aqueous cars, fashioned into the form of beautiful fleecy clouds, so tenderly, so slowly, that we do not see that they are travelling across the azure sky, ever and anon letting fall their humid vapours with such gentle descent that they seem affectionately to kiss and be kissed in return by the thirsty summer trees and herbage.

Yet these same steeds may draw sable chariots, dense, heavy, and lowering, urged forward by the stiletto-pointed spurs of Electros and the fiery flail of the relentless charioteer Prometheus, until they collide, to burst with the artillery of a hundred armies, a deafening cannonade reverberating along the mountain corridors, lighted up the while with transient flashes of overpowering brilliancy when they drop their watery burthens with a precipitancy dealing desolation and devastation near and afar.

THE RIVER'S LIFE

Here, far up on the mountains, the messengers have merely a moderate amount of power for the sawyer. We hear it prettily gurgling and rippling down its stony little course, and we see it going across his hollowed-out tree-trunks by way of conduits. In its own bed we can only see the water running past here and there, for it is beneath a natural conduit of crystal ice, forming a thick arch entirely over it, except at a few air-holes here and there, whilst the hollowed tree-trunks are made fairylike by the quaint stalactitic icicles depending from them. But if we follow the course of this babbling baby stream—walking upon a stony mule-path by its side, more like its own stony bed, here and there crossing a rustic bridge over this crossed brook and ever-eddying stream, lifted even in flood scarcely over its stepping-stones, but through all sweet summer keeping tremulous music with harpstrings of dark water among the silver fingering of the pebbles, where “in the mosslands the soft wings of the sea-angel droop still with dew, and the shadow of their plumes falters on the hills, strange laughings and glitterings of the silver streamlet, born suddenly and twined about the mossy heights in trickling tinsel,” and persevering hour after hour, day after day—we shall catch up to its youth—its noisy, hurrying youth—and then shall we be able to walk hand-in-hand with it in its maturity—heavy, slowly-progressive, voluminous maturity, e'en to its tragic death.

THE POWER OF THE CLOUDS

“Fierce river! to whose strength, whose avarice,
The rocks resist not, nor the vales suffice.”*

“Roll on, thus proud,
Impatient and potent! I would not see
Thy force less fatal, or thy path less free :
But I would cast upon thy waves the cloud
Of passions that are like thee.”†

Ah! with what vehement protest, what blows and buffetings, what roarings and thunderings, does it yield up its ghost to the ocean of soul as it leaps in gorgeous cascade downward with awe-inspiring demonstration of power—the power of the clouds! Dame Nature's busiest masons.

In speaking of the fashioning into form of the earth's surface and the carving into scenery by the inanimate sculptors, we have mentioned that this has been made possible through the circumstance that, upon its first cooling to solidity, it formed a hollow sphere, with a crust composed of material varying greatly in density, hardness, and solubility, and hence differentiating greatly in its ability to withstand wear and tear—a smooth pavement, as it were, or mosaic, capable of enduring very unequally the traffic of time. How the different degrees of hardness should effect its fashioning it is easy to conceive. We have, indeed, only to enter the cool and solemn precincts of a venerable cathedral and tread its uneven stone floor to see how the attrition

* Ruskin.

† *Ibid.*

FOOTPRINTS OF TIME

of time would affect the once smooth mundane pavement. In minster and cloister we find the ancient stone worn into undulating vale and hillock because it varied but slightly in its hardness. But its tessellated slabs in the fulness of time present far greater irregularity; its ceramic pattern—its arabesques of harder material—now stand up above the general level with unwonted asperity; it has its crests and ravines carved by the attrition of Time.

But the effect of varying solubility is equally intelligible. Suppose we make two spheres or balls, the one of pebbles, sand, and cement; the other of pebbles, sand, and soap, and expose them to the weather. The first we know well will withstand both wind and storm, and even after long exposure will still present a surface spherical and smooth. But what of the other agglomerate? This we know equally well will soon suffer change. The laving of the rain will soon deprive it of its smoothly-rounded form; it will be mottled by runlets, tiny streamlets will transport its sand from place to place, its bulk will be worn down, its pebbles will protrude here as a rounded headland, there as a pointed *aiguille*, and—on Liliputian scale—will be revealed the work of pigmy masons and sculptors.

As examples of this on a gigantic scale we have referred to the great clay pillars of the Dolomites,* typical of the weird effect of the washing away of

* See Illustration XLVI.

NATURE'S OBELISKS

soft earth partially protected by harder material. Equally interesting, equally grotesque, are the effects of converse sculpturing, where the removal of the softer and more transient brings to light the harder and more durable.

As an example of this—on a colossal scale—we certainly could not point to any piece of natural sculpturing more entrancing than the one we illustrate, that vast unearthed column or acute pyramid, the Sasso di Ronch, near Caprile. Perched though it is upon the brink of a profound ravine upon a mountain-top, this monument of Nature rears aloft its slender trunk to a height of over 250 feet above the mountain grass, dwarfing into insignificance the herdsman's dwelling beside it. Standing upon its knife-edge of ridge—all pre-



LXIII.

cipice below, all sky above, the horizon one long sweep of jagged peaks—it makes as wild and weird a piece of workmanship as we shall come across in many a wandering. Giant, grotesque, and isolated is the sample of Nature's carving in our illustration upon the opposite page.

So deliberate are Dame Nature's masons, it is not

NATURE'S EVICTIONS

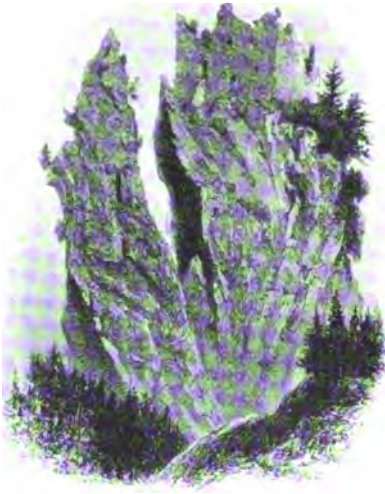
often their building operations inconvenience man during his short lifetime. Interesting exceptions to this, however, are sometimes met with, but seldom in stranger fashion than that illustrated in our photograph (LXV.). Here her workmen secured the eviction of the tenant of the high-perched castle shown. The Castel Pietra, built, as all castles were in feudal times, in a position difficult of access, was originally inhabited by the Counts of Welsperg, who now live hard by in less exalted position, both as to pomp and altitude. Within the last century the rock has so split and its cleft so yawned that the castle has become uninhabitable. Not so long ago, however, the present owner succeeded, with the aid of workmen, ropes, ladders, and other auxiliaries, in paying it a visit. But it now stands keeping lone and silent sentry over the entrance to the romantic Val di Canali, near Primiero. One has only to look at the great body of the disengaged rock and the angle at which it leans to appreciate that in a very short time—geologically speaking—it will be hurled down, perhaps to form a foundation, solid and secure, for the houses of valley dwellers.



LXIV.

NATURE'S EVICTIONS

We do not know of a gorge—and subsequently a valley—more plentifully bestrewn with vast masses and giant boulders which have descended from time to time from the frowning and overhanging mountain ranges above, than that which leads from the



LXV.

summit of the Splügen Pass down into Italy at Chiavenna. And there we see the extraordinary spectacle of the dwellings of the inhabitants built upon these great cruel boulders, positively those which had fallen previously, o'erwhelming and crushing the villages erstwhile nestling there, and all but annihilating the ancestors of those now

dwelling upon these veritable gravestones of Nature. A view taken in such a boulder-bestrewn Italian *val* is presented in the photograph opposite.

We have referred to the fact that the falling of snow upon the mountain summits would rapidly—computed by mountain time—cause the chain to increase in altitude, a process, as we know, which does not take place. The compensation is due to

NATURE'S COMPENSATION

three operations on the part of Nature's masons :
(a) The dissolution of the snow and the formation of rivers ; (b) the intermittent sliding down of snow-fields and masses ; and (c) the constant creeping down of vast volumes of ice as glaciers.

In the first and last of these the masons perform their enormous task with but little noise, yet sometimes

“Down rugged
gorges, and
below—

Half muffled by
the wastes of
snow—

Acataraet in thun-
der booms”;



LXVI.

whilst in regard to the second, the manifestation of their might is oftentimes awful and appalling.

“Beware! the awful avalanche,” counsels Long-fellow—this being the name given to the sudden descent of huge snow-fields—and well may he do so ;

“For there are sudden dangers none foreknow :

The sound-loosed avalanche, frost-cloven rock,
Or whirling storm of paralyzing snow.”

The “silent, watching mountains” we have said, and that is what one deems them from afar. We know that in accord with one of Dame Nature's

AVALANCHES

inviolable laws, "the survival of the fittest," all animate nature is at war; we know also that this extends to vegetative nature, but one would scarce expect it to hold good also upon the mountain summits. Yet e'en up here—high above the habited world—we still witness this strife. We see the rush of inanimate chargers; we see the thrust and parry; we hear the crash of Nature's armour, the shattering of her lances; we witness the success of the conqueror, the fall of the vanquished. Here in this vast uplifted arena are

"Snows, torrents, to the region's utmost bound,
Life, death, in amicable interchange.
But list! the avalanche, the hush profound
That follows, yet more awful than that awful sound!"

Avalanches are most to be feared in late spring, and he is to be congratulated who may have seen "a mighty avalanche's fury roll," spreading desolation all around in a space so short that there is scarce time to appreciate what is happening—devastation years will hardly obliterate—and yet return unhurt.

"All in a moment, crash on crash,
From precipice to precipice,
An avalanche's ruins dash
Down to the nethermost abyss.
Invisible, the ear alone
Follows the uproar till it dies;
Echo on echo, groan for groan,
From deep to deep replies."*

* J. Montgomery.

AVALANCHES

At first quite noiselessly the vast snow-field commences to move—it may be, as the poet says, “sound-loosed”; it may be the stress gravity has long put upon it has at length overmastered it, and, with motion so slow as to be scarcely discernible, it commences to descend, usually its lower central region being the first to move. A vacuity is thus formed above, and into this the laterally lying snow-fields commence to slide; the pressure thus set up causes the upheaval of a rampart of snow forming its lower margin. Building up rapidly, the embankment thus formed assumes a curved form, by reason of the centre of the slip travelling the faster, and consequently the tensile strain set up causes the gliding mass to burst out in fanlike formation. Flying over and dragging with it fresh fields, the speed of descent has now become terrific. Many times wider than when it first commenced to descend, the avalanche—still composed alone of snow and ice—rushes from the realms of eternal snow across the boulder-bestrewn border, catching up the rocky fragments in its seething, flying mass, and hurling them downwards across that band of lithic desolation, onwards with appalling speed into the pine-clad belt. There 'mid the deafening, crashing, splintering, and uprooting of many an erstwhile silent and stately forest veteran, it hews out a course for itself, bearing onward many a trunk it has felled far down into the valley, where it crumples up the

THE CLARION OF NATURE

herdsman's timber *châlet* as might a giant dragon's jaws, razing and engulfing whole villages, o'erthrowing steeples, breaking bridges, e'en damming up with its momentarily-acquired *débris* the broad beds of wide and swiftly-flowing rivers. And then arises

"A clarion like the unfurling of loud thunder
Among the echoing ravines and rocks,
The hoarse roarings of turbulent, elemental shocks
Rolling afar to tell of devastation wrought."

Indeed, it sometimes happens that the blocking up of the valleys by the avalanche is but the prelude to a far more wide-reaching catastrophe.

Take, for instance, the floods which inundated the plains of Martigny in 1818. Early in that year it was found that the Valley of the Bagnes, one of the large side-valleys of the great Valley of the Rhone above Geneva, had been converted into a lake through the damming up of a narrow outlet by avalanches of snow and ice from a loftier glacier overhanging the bed of the river Dranse. The temporary lake thus formed was no less than half a league in length and more than 200 yards wide, its greatest depth exceeding 200 feet. The inhabitants perceived the terrible effects which must follow when the barrier burst, which it could not fail to do in the spring. They therefore cut a gallery 700 feet long through the ice, while as yet the water was at a moderate height. When the waters began to flow through this channel, their action widened and

A CATASTROPHE

deepened it considerably. At length nearly half of the contents of the lake were poured off. Unfortunately, as the heat of the weather increased, the middle of the barrier slowly melted away, until it became too weak to withstand the pressure of the vast body of water. Suddenly it gave way, and so completely that all the water in the lake rushed out in half an hour. The effects of this tremendous out-rush of the imprisoned water were fearful.

“In the course of their descent,” says one account of the catastrophe, “the waters encountered several narrow gorges, and at each of these they rose to a great height and then burst with new violence into the next basin, sweeping along forests, houses, bridges, and cultivated land.” It is said by those who witnessed the passage of the flood at various parts of its course that it resembled rather a moving mass of rock and mud than a stream of water. “Enormous masses of granite were torn out of the sides of the valleys, and whirled for hundreds of yards along the course of the flood.”

M. Escher, the engineer, tells us that a fragment thus whirled along was afterwards found to have a circumference of no less than sixty yards. “At first the water rushed on at a rate of more than a mile in three minutes, and the whole distance (forty-five miles) which separates the Valley of Bagnes from the Lake of Geneva was traversed in little more than six hours. The bodies of persons who had been drowned

A CATASTROPHE

in Martigny were found floating on the further side of the Lake of Geneva, near Vevey. Thousands of trees were torn up by the roots, and the ruins of buildings which had been overthrown by the flood were carried down beyond Martigny. In fact, the flood at this point was so high that some of the houses in Martigny were filled with mud up to the second story."

It is to be noted respecting this remarkable flood that its effects were greatly reduced in consequence of the efforts made by the inhabitants of the lower valleys to make an outlet for the imprisoned waters. It was calculated by M. Escher that the flood carried down 300,000 cubic feet of water every second, an outflow five times as great as that of the Rhine below Basle. But for the drawing off of the temporary lake, the flood, as Lyell remarks, would have approached in volume some of the largest rivers in Europe. "For several months after the *débâcle* of 1818," says Lyell, "the Dranse, having no settled channel, shifted its position continually from one side to the other of the valley, carrying away newly-erected bridges, undermining houses, and continuing to be charged with as large a quantity of earthy matter as the fluid could hold in suspension. I visited this valley four months after the flood, and was witness to the sweeping away of a bridge and the undermining of part of a house. The greater part of the ice-barrier was then standing, presenting

ANOTHER CATASTROPHE

vertical cliffs 150 feet high, like ravines in the lava-currents of Etna."

This dire calamity, as we have seen, was brought about by avalanches blocking the mouth of a valley and converting it into a temporary lake. Had the avalanche been an earthly or lithic one instead of snow, the lake in all probability would have remained to this day, and thus in a single hour, as it were, a great and lasting change would have been effected in the scenery. Such a change—were not proper precautions taken—might take place, as we have mentioned, in the *Val de Travers*. But avalanches and landslips sometimes accomplish gigantic work and dire devastation in an opposite manner; that is to say, by filling in lakes instead of forming them.

In this regard it may be interesting to refer to one of these lightning changes, accompanied by a catastrophe, which occurred just beyond the Alps little more than a century ago.

It took place in the lovely and romantic region of the Dolomites, where, entrapped among their barren and rocky ridges, lies the Lake of Alleghe. In a green amphitheatre at the foot of the Civetta, the Monte Pezza, and the Monte Fernazza hurries along the Cordevole, dark, deep, and brown, towards the blue and placid lake. The river is as old as the hills, the lake a thing of yesterday, and where it now mirrors the fleecy clouds and towering moun-

ANOTHER CATASTROPHE

tains orchards grew and cornfields waved, and farms and villages nestled in the verdant bottom. Terrible catastrophes wrought by mountain-slips or bergfalls, as they are here called, have occurred often, but never with greater frequency or on a more tremendous scale than in these romantic regions. One can scarce cycle a dozen miles without happening upon a scene of ruin. It may have happened last year, or last century, or in prehistoric ages. There lie the great rocks, piled on high and crushing beneath them their buried secrets, presenting often no outward difference or tangible evidence to tell which fell within the memory of man and which before the date of man's creation. The history of this lake, however, has been handed down with unusual accuracy, the date of the calamity and the extent of the damage done being registered in certain parish books and municipal records, and these, again, supplemented by deeds and papers preserved by private families in the neighbouring villages. Most of the families, indeed, can tell of ancestors killed, their houses and lands buried.

The Monte Pezza lies to the west of the lake, being the largest of the three mountains mentioned. Northwards, it breaks away in abrupt precipices, culminating in a fine rocky summit some 8,000 feet above the level of the sea ; but on the side nearest the lake it slopes down in a succession of rich woods, pastures, and picturesque ravines. Skirting

THE MIGHTY RUSH

the opposite shore, one sees a vast, treacherous, smooth-looking slope of slatey rock, like a huge bald patch, extending all along the crest of the ridge on that side. It was from thence in 1771 that a great landslip occurred. The crest, indeed, slid, slowly at first, and then with terrible swiftness, down into the valley.

A charcoal burner, it is said, who had been at work in the woods, came down towards close of day, white and breathless, calling on those in the plain to save themselves, for the mountain was moving. A swift runner, with the fear of death behind him, he fled from village to village, raising the cry as he went. But no one believed him. Four villages then stood where now lies the lake. Incredulous of danger, the people of those four villages went to bed that evening as usual, and in the dead of night the whole side of the mountain came down with a mighty rush and overwhelmed the sleepers, not one of whom escaped. Two of the villages were buried and two drowned, for the waters of the Cordevole, driven suddenly back, spread out, and formed the lake as we now see it. The two buried hamlets lay close under the foot of the mountain at the southern end of the basin, where great masses of *débris* now lie piled in high confusion. Alleghe, the chief place of the district, was situate somewhere about the middle of the lake, and is wholly lost to sight. The fourth village stood on a slope at the north end,

THE MIGHTY RUSH

close against that point where the Cordevole now flows into the lake.

Four more months went by, and then there occurred a second downfall. This time the waters of the lake thus formed were driven up the valley with great violence, destroying even more property than before. In the little village which is now called Alleghe, and has been so called ever since the first Alleghe was effaced, the whole east end and choir of the present church were swept away, and the organ was carried to a considerable distance up the glen. At the same moment—for the whole lake seems to have surged up suddenly as one wave—a tree was hurled in through the window of the room in which the curé was sitting at dinner, and the servant waiting upon him was killed on the spot. The choir has been rebuilt since then, and the organ, repaired and replaced, does duty to this day. Neither monument nor tablet has ever been erected to the memory of those who perished in these two great disasters, but a catafalque is dressed, and candles are lighted, and a solemn commemorative mass for the souls of the lost and dead is performed in the church at Alleghe on May 21 in every year.

The villagers say that in winter, when the lake is frozen and the ice not too thick, and in summer on very calm days, the walls and roofs of one of the submerged villages may yet be seen, like the

THE VILLAGE IN THE LAKE

traditional towers of the drowned city of Lyonesse, far down below in the depths of the water.

To this undoubted fact the simple dwellers add embellishments characteristic of their superstitious fantasies, an old dame adding to her seriously-delivered assertion that many and many had been the time as she rowed her little *baca* across the calm lake she had peered down to view the roofs beneath which lay the corpses: "Dio mio! There are those in Alleghe who have seen stranger sights than I. There are those living who have seen the old parish church, with its belfry all perfect, out yonder in the middle of the lake where it is deepest. There are those living"—here her voice dropped to an awe-struck whisper—"who have heard the bells tolling under the water at midnight for the unburied dead."

Vast as is the individual work performed by these masons of Nature, who thus suddenly mould and remould the glorious scenery, yet in the aggregate the work done by them in the general sculpturing of the face of the land probably does not amount to a large proportion of the combined work of these labourers. Still, their work is of a nature which appeals both to our admiration and to our dread, for it is such as has to be guarded against. We must perforce, indeed, set up ramparts and entrench ourselves against their onslaughts. This the dwellers amid the mountains do in two principal ways. As

AVALANCHE BASTIONS

we journey through the valleys we often see the village church—to the sanctuary of which the inhabitants often flee for safety — protected by a strong masonry wall or groin. This often takes the form of a fender or triangular bastion, with its pointed edge projecting outwards in the direction from which the oncoming avalanche will advance, so that its headlong rush may be stemmed, its rushing mass cloven in twain and made to *ricochet* down into the valley on either side of the sacred *bâtiment*, which may thus be spared.*

Another mode of defence, less effective, however, which we meet with more frequently in the Tyrol, is the provision of a *chevaux de frise*, by the planting of a wide belt of fir-trees a short distance above the villages. These outposts against the invader are maintained for the public good, and very heavy penalties are inflicted upon any inhabitant who may tamper with them. When, however, the avalanche is of a serious nature—when it brings with it pine trunks and great boulders—such ramparts avail but little, for, as an exemplification of the resistless battering to which they may be exposed, we may mention that on one occasion we measured a single rock which had been thus flung down containing over 500 cubic feet of stone. Now, this would weigh at least a couple of tons, and assuming

* The additional massy building on the Great St. Bernard is thus arranged.

SNOW VIADUCTS

it to have been endued with the velocity it must have acquired, this mountain-spel projectile would give a force of impact equal to that of the weighty shell fired by a very large gun.

Avalanches are of two kinds. The first, which are highly irregular in their action and fall, and consequently the more dangerous, are due to heavy accumulations upon steep slopes, when a surface or bodily disruption gives rise to their descent, accompanied by vast clouds of dust-like powdered snow. The second are caused by sub-superficial waters. In this latter class water from superficial thawing percolates beneath the surface, and, burrowing beneath, hollows out great cavities and renders the mass unstable, so that by shock imparted to it, or by collapse from mere weight of the superincumbent mass, the whole is put into motion. These, being fairly regular in their movements, can to an extent be warded against.

The action here referred to gives rise to a most interesting Alpine phenomenon, the building by Nature's masons of ice bridges. These are sometimes of great size and span—"The place of torment, where the marble pavement of the stony ground is ice alone"—being carved with such dexterity and apparent artificiality combined with strength that mountaineers are enabled to pass over them in their ascent and descent of the summits. In our illustration we see the mode of negotiating such a natural

SNOW ARCHES

ice bridge some sixty or seventy feet in width. The intrepid mountaineers and their guides must needs pay their genuflections to the surprising work of Nature, and, stealthily crawling—roped together and ice-axe in hand—they, with tense nerve and watchful eye, slowly make their dangerous passage across the bridge.*

Not the least appalling attribute of the avalanche,



LXVII.

adding at the same time to the impressiveness of the scene, is the deafening noise echoed and re-echoed from side to side of the mountain gorge, the echoes merging to form a veritable roll

of thunder. It is instructive to reflect upon the cause of this.

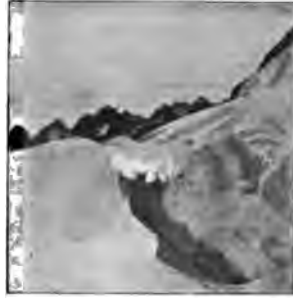
We all know that if two mirrors be placed parallel and opposite to each other and a lighted candle put between them, an infinite number of reflections of the candle-flame are produced in long regimental array, their brightness gradually diminishing as they recede from the source of light. If the mirrors

* The photograph was obtained by Mr. H. Somerset Bullock.

MOUNTAIN ECHOES

be placed at an angle, then the smaller the angle the greater the number of images formed. So it is with an echo. The ear takes the place of the eye; the sounding body of the falling avalanche is the counterpart of the light of the candle, the echoes of the reflected images, the sound diminishing as they recede. Hence, as the echo continues—which it does for a considerable time—from the fact that the velocity of sound is comparatively slow,* the volume of sound gradually diminishes until it finally dies entirely away.

The blow of a stick or hammer against one side of a parallel fissure in a rock is sometimes found to produce the sound of a bell. In this case the repetition of the first sound, by successive reflec-



LXVIII.

tions, is sufficiently rapid to produce the impression of a continuous and definite tone. The bell-rock at Tunbridge Wells is a well-known example of this.

Now, the mountain cliffs are so many rough reflectors placed at all sorts of angles to one another; hence we get not only thunder from the avalanche, but those beautiful Alpine echoes which delight our ears in different localities. In our illustration we

* Some 1,090 feet per second when the thermometer is at freezing-point.

MOUNTAIN ECHOES

see the venerable Switzer blowing his long wooden Alp horn in the Lauterbrunnen Valley.

To the echo also is attributable the almost terrifying effect of thunder amongst the mountains. Thunder, as we know, is produced by the short, sharp crack of the electric spark as the electricity of one cloud is discharged into another or into the earth, a crack of but momentary duration;* yet this report comes to us again and again reflected from the surfaces of the storm-clouds, and in such quick succession from those near at hand that the first echoes produce that startling crash following—more or less leisurely—the vivid flash, whilst the more distant beds of cloud send back their reverberations much later to merge into that long roll



LXIX.

of thunder which almost makes us think the sound to be still taking place afar off.

A striking and beautiful effect of echo is produced in certain localities by the Swiss mountaineers, who contrive to sing their *ranz des vaches* in such time that the reflected notes form an agreeable accompaniment to the air itself.

* Sir Charles Wheatstone concluded, from a number of experiments made by him, that lightning does not last so much as a thousandth part of a second.

CONTRAST

It is strange to be at night-time in a silent valley, and to watch the lightning flashing up over the mountain crests some miles away. Sheet after sheet of flame seems to play round the distant crags and summits, yet not a sound is heard; one knows, however, that over in the valley beyond those mountains the storm is raging loud enough, and it is only the intervening range which keeps the turmoil from us, while it is unable to screen off the reflection of the lightnings from the gaze of the surprised observer.

We have now descended from the mountain's summit to observe the gash graven out by the chisel of Dame Nature's sculptor, *Avalanche*. Let us now ascend once more to watch the working of another of her masons—one whom we shall find working, albeit unceasingly, yet less noisily—the mason *Gletscher*.

As we turn again towards the mountain crests, that same feeling of awed respect, of vivid expectation, of profound admiration, again fills us. What can it be that thus fascinates us? A moment's reflection tells us it is contrast. It is the contrast between the mighty vigour, the ceaseless warring all around us, with the somnambulance, the restful tranquillity, of the lowlands.

“Mountains are to the rest of the body of the earth what violent muscular exercise is to the body of man. The muscles and tendons of its anatomy are in the mountain brought out with force and

THE LANDES

convulsive energy, full of expression, passion, and strength; the plains and the lower hills are the repose and the effortless motion of the frame, when its muscles lie dormant and concealed beneath the lines of its beauty."*

To experience to its full this contrast, we have only, on descending from the heights, to visit such lowlands as are to be found comparatively near at hand, on the coast of France. In rushing across *La Belle France* upon a high speed motor-carriage, whilst enjoying the keen exhilaration due to the rapid transportation of ourselves across the face of the country, we have felt it discounted by the long flat stretches of the *paysage* and the monotony of the successive undulations of the gently-welling *côtes* and *collines*. And such feeling attains its climax on entering upon the margin of that great sea-level plateau known as the *Landes*.

Amidst these wastes, lying to the east of the pine forests which fringe the sea-coast, the Landais, who are with a few exceptions shepherds, spend the long summer days with their flocks, each animal being as well known to them as their dogs. The Landais shepherd is a primitive being, and fond of solitude. He rarely ventures near the railway, and when he does, he gazes wonderingly and distrustfully at the rushing train or *automobile*; therefore, to visit him one must needs penetrate into his wilderness.

* Ruskin

THE LANDES

“A bare strand
Of hillocks heaped from ever-shifting sand,
Matted with thistles and amphibious weeds,
Such as from earth's embrace the salt ooze breeds.”

There among the great waste, clothed in sheepskins and wearing the Navarre cap, we find him, mounted on tall stilts—become from long habit like a second pair of legs, for he has been accustomed to them from childhood—probably knitting while his meagre flock crop the scanty herbage. There he stands, resting upon his pole, a strange tripodic-looking figure. Stranger still he appears when striding across the Landes in hot haste after a wandering sheep. He has a small hut, sometimes a wife, who aids him in cultivating a small patch of ground, from which he obtains a little corn and a few vegetables. A miserable existence, surely; but the dawn of brighter days has, we may hope, appeared for the poor Landais. In our illustration we see the Landais postman upon his rounds.



LXX.

Such lowland wastes are inevitably unhealthy; indeed, the inhabitants have a proverb—

*“Tant que Lande sera Lande,
La pellagre te demande,”*

THE THEATRE OF DECAY

the pellagre being a fatal disease occasioned by malaria and bad water.

Surely such contrast with the brusque, health-imparting steep we are now climbing is antipodean. When first ascending we were interested in the changes due to the painters of Nature, whilst on the last occasion we briefly noted the transmutations wrought by Nature's sculptors. But the work of the latter, albeit the more arduous, proceeds more slowly, and is thus less readily appreciated.

"As Lyell has remarked in his '*Principles of Geology*,' our position as observers is essentially unfavourable when we endeavour to estimate the nature and magnitude of the changes now in progress. As dwellers on the land we inhabit about a fourth part of the surface, and that portion is almost exclusively a theatre of decay, and not of reproduction. We know, indeed, that new deposits are annually formed in seas and lakes, and that every year some new igneous rocks are produced in the bowels of the earth, but we cannot watch the progress of their formation. And as they are only present to our minds by the aid of reflection, it requires an effort both of the reason and the imagination to appreciate duly their importance. But that they are actually of extreme importance, that, in fact, all the most characteristic features of our earth at present are due to the steady action of these two causes, no geologist now doubts."

“THAT QUANTITY OF TIME”

The difficulty the casual observer has to contend with consists in his inability to picture in his mind the gigantic dimensions to which the changes he sees evidences of actually taking place around him would attain by the lapse of immense periods of time. In like manner he is unable adequately to conjure up a mental picture of what his surroundings really did present at such immensely distant epochs.

“What more is required to explain the configuration of our mountains and valleys? Nothing but time. It is not any part of the process that will be disputed; but, after allowing all the parts, the whole will be denied, and for what? Only because we are not disposed to allow that quantity of time which the absorption of so much wasted mountain might require.” Thus wrote that student of the mountains, Hutton, long years ago.

Scrambling over the rocky *débris*, we are now close to the lower end of the glacier. We clamber upon its glissant surface and find it very wet, whilst from its lower extremity we see hastening away, dancing and frolicking in the sun, a by no means inconsiderable rivulet. Obviously the *gletscher* is rapidly thawing. Yet just above us is the “eternal” snow, and we recall that far up towards the summit everything was hard and crisp, and we saw but slight evidences of rapid thawing. Moreover, we knew that it was intensely cold up there, yet

SNOW UPON THE MOUNTAINS

our skin was sadly scorched by the powerful sun.*

All these things are strange, and we ponder upon them as we ascend. We have now entered the realm of eternal snow, long since crossed its margin, and after hours of arduous climbing we have scaled some 15,000 or 16,000 feet, and thus approached three miles nearer to the glorious dispenser of heat. We know that we are in the "colder" altitudes. True, a tierce of miles is but a pigmy thing in com-



LXXI.

parison with 92,000,000 we should have to journey to reach him, but surely it is strange that in approaching the fire we should get colder. We turn and look down upon the valleys. There they lie, wrapped in verdure; the snow that covered them during the winter has long since all melted. We,

however, are amid it, yet wipe the perspiration from our brow: our face is becoming blistered. We do not feel the cold; intense though it be, the air seems almost mild and balmy.

We have mentioned that snow upon the mountain summits is entirely dissimilar to snow as we know

* To mitigate the blinding effect of "snow glare," dark glasses are worn; whilst to protect the skin from sun-blistering, the face is often liberally besmeared with vaseline and fuller's earth.

SNOW CAVERNS

it bestrewing the lowlands, but this requires a slight qualification, inasmuch as freshly fallen snow is not materially dissimilar—"drier," more powdery, and rather more compact it may be. Such snow, as we know, is invariably of dazzling whiteness, but we also know that if we cut a cavern in it in our own fields or gardens, such cavern will *not* be illuminated by a blue or green light, but merely by a cold and gray suffusion. Yet again we know that, viewed from hundreds—even thousands—of feet below, we see the Alpine snow-caverns emitting a decided pale-green hue.

We may say at once that almost from the hour of its falling upon the mountain-ridges snow commences to undergo a change, and continues to pass through various transmutations until it at length—having passed through the stage of glacial ice—appears at the valley-head as water. Such changes are of great interest, and warrant more attention than we can give them here.

Why the snow should lie up there, eternally



LXXII.

THE SNOW LINE

enshrouding the venerable heads in cowl and capuche, whilst not so far above the higher valleys the summer sun is able to melt away all below a certain line—the regularity of such line being not the least interesting feature of the phenomenon—is a question we hear frequently asked in travelling amongst the Alps.

Perhaps the simplest way of approaching it is to reflect that not alone the mountains, but the atmosphere above our own fields and meadows has its snow-line. Yet it is strange to ponder, as we stretch ourselves out in a sweet-smelling meadow on a hot summer day, that right above us, a mile and a half above* our heads, it may be snowing. Nay, more ; that those delicate and fantastic cloudlets may be of fine and deliciously cool snow.

Stranger again to think that the warm drops of the afternoon shower—so softly, silently falling upon the thirsty grass and grateful crops around us—were born in those same chill cloudlets we see so gracefully gliding and so mysteriously disappearing from the lovely blue semblance of space.

We have only to picture to ourselves our world enveloped in an invisible envelope, not so far above it, and corresponding to the isotherm of the freezing point, and to reflect that such invisible veil would be found lying upon the ocean at the poles, and then rising in an arched canopy as it stretches equatorwards, cutting off the tops of the Himalayas at

* In India it would be about three miles.

THE SNOW LINE

18,000 or 19,000* feet, descending, in passing over Europe, and shrouding in whiteness all our Alpine regions above about 9,000 feet, again coming to earth at Greenland. Therefore, if snow—and not rain—be formed in the air beside the Alps at all altitudes above a couple of miles, then must it fall upon the mountains as such.

It is still more interesting to reflect that the Alpine summits are perpetually covered with snow by reason of their great height, and also because they are so low. In other words, if they soared up yet higher above the earth, their snow-caps would disappear, and for the simple reason that the region of cloud, snow, and rain extends upwards to a comparatively moderate distance, above which little, and subsequently no, moisture is to be found.

But the question may at once be asked, If the sun in the valley is sufficiently powerful to melt away the snow, why should not it do so upon the mountains? To answer this, we must appreciate two facts : firstly, that the sun *does* melt the snow above the snow-line as well as below it ; and, secondly, that by that word is understood the line along which the snow falling *year by year* is melted, and no more.

Why the mountain snow should not be entirely

* The snow-line upon the south side of the Himalayas is about 1,200 feet lower than upon the north side, principally because the warm, dry air from the heated plains of Thibet is able to melt the snow to a greater height.

THE COLOUR OF SNOW

melted ; why rain should not fall in the higher altitudes ; and why, but a moderate distance above the earth's surface, we should—despite the brilliant sunshine and the great heat imparted to us here in the lowlands—find ourselves in regions of intense and perpetual cold, are questions of transcendent interest, which we have ventured to touch lightly upon in the Appendix.

To recur to the colour of the snow. Snow is white physically, because its structure *en masse* is such that it reflects equally all the colours of which white light is composed. It consists, as we have said, of beautiful little flowerlets, built up of minute needles or crystals of ice, and if these have been born in calm air they will be found to be formed, not only symmetrically, but invariably of stars having six rays of feathery surface, from the abundance of minute crystals of ice ranged along their sides.

But the reader may urge, If snow be flowerets of ice—the colour of ice being, as we know, blue—whilst, moreover, if we examine a snowflake upon our coat, we find it emitting all the prismatic colours of the rainbow—why, then, should a snow-field be white ? It is because the myriad reflections of these colourings *combine* to form white light, just as, if we paint the colours of the spectrum—or the seven principal ones thereof*—upon a card and spin it

* The seven principal colours of the spectrum are : red, orange, yellow, green, blue, indigo, violet, easily remembered by repeating the words : “ *Read Over Your Good Book In Verse.* ”

THE NÉVÉ

round, the colouring instantly disappears, and the card becomes white. What can be deeper blue than the calm Mediterranean? yet the caps of the surges rolling upon its *riviera* are white, indeed, for they reflect the light from myriad air-globules.

That ardent student of Alpine snow and ice, Professor Forbes, said of the latter it was sufficient to say that the colour of ice was blue, because that was the colour of water.* But the colour of the snow-clefts, crevasses, and grottos is a beauteous green. This, however, is easily explained. The snow up there consists half of snow, half of ice, for as it melts, the water permeates into the interstices, and there freezes, so that we get the blue colour of the ice modified by the white of the snow. But the next lesser refrangible colour to blue is green, and there we see an effulgence of green, of resplendent, yet softened, beauty.

The snow, thus agglomerated, is called *firn* or *névé*, and is so hard that, frequently, one cannot pick it up, even with the nails. It were pardonable, therefore, to, at first blush, consider it *per se*—there far above the permanent snow-line—as permanent snow. Yet we have only to reflect that if this were so, then every mountain, whose summit is above the snow-line, would increase in height year by year. Indeed,

* Visitors to the maritime grotto of Capri have pleasurable occasion to know the lovely rich azure sunlight becomes after passing through a thickness of water. The blue lake near Kandersteg is another lovely example.

THE RIGID RIVER

the waters of the ocean, carried thither by the clouds, and piled upon their summits in solid increment, would raise the mountains indefinitely, until, indeed, they penetrated into the regions of atmospheric dryness. But then there are Nature's masons to be counted with.

We have mentioned avalanches as a factor in the removal of snow from the mountains, but these, unaided, would be powerless to play the part of removal contractor for such colossal accumulations. One of the most industrious and interesting of Nature's masons, however—always labouring—is prepollent to silently perform a far more Herculean task than the loud-voiced avalanche—the slowly downward-creeping glacier.

Locked in the frigid embrace of the stern mountains are many phenomena arousing our interest and our profound admiration, but we know of none so absorbing, so worthy of study, as the movement and work of the glaciers.

“Imagine a mighty river of as great a volume as the Thames started down the side of a mountain, bursting over every impediment, whirled into a thousand eddies, tumbling and raging on from ledge to ledge in quivering cataracts of foam, then suddenly struck rigid by a power so instantaneous in its action that even the froth and fleeting wreaths of spray have stiffened to the immutability of sculpture. Unless you had seen it, it would be almost

THE RIGID RIVER

impossible to conceive the strangeness of the contrast between the actual tranquillity of these silent crystal rivers and the violent descending energy impressed upon their exterior." Thus picturesquely does Lord Dufferin give his impressions of a vast glacier.

Few can repress an expression of awed admiration



LXXIII.

on approaching, for the first time, the margin of a colossal *Gletscher*. One may have been for long hours tramping through snow-fields of dazzling whiteness spread out around us in curvilinear undulation—monotonous from their vast expanse and lack of colouring, blinding from the brightness and whiteness of the reflected sunshine—when suddenly we come upon a great sea of ice, not a solid lake of smooth and placid surface, but, as it were, an ocean

CONTRAST

in tumbled, turbulent, and angry turmoil, struck motionless! That is one's first impression: a giant, frigid river arrested in its flow and now immutable, changeless, stationary—dead.

We sit down beside it to contemplate its solemn grandeur.

“When, upon the mountain's silent brow
Reclined, we see, above us and below,
Bright stars of ice, and azure fields of snow.”

And when we have become more attuned to our surroundings, and awe gives place to admiration, we appreciate that though they are indeed solemn and majestic, yet are they not silent.

The contrast between an angry, tumbling, restless river and a calm, placid, peaceful lake is typical of the emotions they each inspire within us. The gorge of a shallow, foaming, noisy river is a place of unrest, inspiring in us a desire to be up and doing, to be ourselves in vigorous action. The expanse of a deep, calm, and silent lake has a narcotizing effect upon us, rendering us loath to stir, imbuing us with a feeling of lassitude, a desire to float motionless and idly upon its bosom, and meditate.

What are our feelings up here beside the great glacier? They are dual. Our first wish is to clamber upon it and explore its wonders, our second to sit and meditate upon them.

It is indeed lovely up here, far above animate

SOLITUDES OF SNOW

Nature, e'en above the fir forests. Not a twit of bird, not a silently scampering little squirrel with his great, important tail so pompously curved up over his back, not a "bunny" with his little white apology for one so contemptuously hopping along in front of us, no movement to be seen save that of the



LXXIV.*

clouds. Yet is there plenty to study, much to ponder upon.

"O deep, exalting freedom of the hills !
O summits vast, that to the climbing view
In native glory stand against the blue !
O cold and buoyant air, whose crystal fills
Heaven's amethystine bowl ! O speeding streams,
That foam and thunder from the cliffs below !
O slippery brinks and solitudes of snow !"

* The above illustration of a giant *Gletscher* is of especial interest, as it shows a portion of the *Morjelen* or *Margelen* Sea, with icebergs floating upon it. We have referred to this, and to the

SOLITUDES OF SNOW

As we sit we presently awaken to the fact that far from there being "silence all around" there must be movement all around, for—now as we listen attentively—we find that not a minute passes—nay,

extraordinary phenomenon connected with it—namely, that it suddenly disappears about every seven years.

A similar, and apparently miraculous, evacuation has occurred recently in the Tyrol, where the waters of Lake Vernagther, formerly the pride of the valley of Oetzthal, have suddenly disappeared. The village watchman (so says an account of the catastrophe) was positive that when he passed its banks the night before the remarkable discovery the lake was in its usual condition. The fact, however, remains that in the morning nothing but the bed of the lake was left to show that Lake Vernagther ever existed. The bed of the lake was much too muddy to admit of any extended investigation as to the cause of the sudden disappearance of the water, and so it was not until some weeks had elapsed that any attempt toward that end could be made. In the meantime, the banks of the lake were constantly crowded with curious visitors and villagers, some of whom waited in the firm belief that the prodigal waters would return as suddenly as they had disappeared!

On the trees growing near the lake some wag had caused to be posted large notices headed, "Lost, Stolen, or Strayed," to the effect that a reward would be paid for the return of the missing waters and "no questions asked." Another notice exhorted the missing waters to return, and all would be forgiven. Needless to say, these notices had no effect. When the bed of the lake was sufficiently dry, an examination was made, which revealed the fact that a large opening had been broken through the bottom of the lake, and through it the waters had run.

These phenomena creating much interest and speculation, we have ventured to touch upon their causal scientific principles in our Appendix.

A MONSTER VAST AND VAGUE

scarce a few seconds—but some sound is heard ; here a rumbling, there a grating, ever and anon the smart crack of ice fracture, and again the report and re-echoing of concussion and collision between speeding ice or rocky fragments. It is a scene weird and impressive, for—

“ This glacier stream compact of welded snows,
A flowing solid of translucent ice,
Brim to its verge a flinty gorge ; there it lies,
Extended in the sunshine silently—
A charmed frost-dragon in steel-gleaming scales ;
Coiled close the crags between in many a fold,
And sinuous curve, and glancing, fretful ring,
Like that strange serpent-beast, the Fafnir foul,
That gloats above the Niblungs’ ruddy gold.
A monster vast and vague, whose horrent spines—
The nodding *séracs* on his bended neck—
Tall, bristling as a feudal city’s towers,
Make show of kindling anger ; whose blue mouths,
A thousand grim crevasses, spread their jaws,
Like graves in sapphire hewn for living men.”

The December sun is shining brightly and powerfully ; it is mid-day, and the process of melting is therefore going on at its highest rate. What impresses us forcibly, and we feel sure under like conditions will our readers also, in contemplating the novel and entrancing spectacle is the incessant movement taking place above and below the surface of a glacier ; and this accompanied by the most impressive sounds in the otherwise perfect silence and stillness. There are varied sounds from varied

ICY PROJECTILES

sources, but the source from which the sound emanates is generally invisible. Motion is taking place in all directions, yet in tantalizingly few instances does one have the good fortune to see the movements. This is easily explicable, for the causal sound almost invariably is emitted upon the sudden *cessation* of movement. The most frequent noises are caused by the sudden and rapid sliding down of moraine stones and pieces of rock. These, however, although they go swiftly gliding over the highly glissant and steeply inclined planes of the billowy surface, do so quite noiselessly. Not so the sudden arrest of such weighty fragments in their swift course. It is then that the noise is heard.

A great, several hundred-weight stone will come skating down at immense speed—noiselessly and quite unseen—fly across a wide crevasse, and strike with great violence against its opposite face. This will give a report sharp as that of a musket. We instantly look in the direction from whence it came; but we are too late: by now the lithic projectile is flying with bullet velocity unseen down the crevasse in zigzag course—striking one side, glancing off the slippery surface but to strike the other and be promptly reflected, tossed and re-tossed between the opposing faces, and so on as it falls lower and lower into profound depths. That it is which gives rise to the deep thuds, the hollow gurglings, so constantly to be heard.

DEMOLITION

Ever and anon a great slab of ice weighing many tons will suddenly detach itself, slide rapidly over the icy surface—

“With flight as swift as swallow’s
’Twill sweep the curdled lake,
Where the groans of prisoned kelpies
Make the firm ice-pavement quake”—

to be instantly and with startling noise dashed into a thousand fragments by its vast impact against some massive uprearing pinnacle, perhaps to snap it off and overturn it. We hear the running of water. There a gradually hollowed-out snow-arch, which its constant streaming has made, suddenly collapses with a roar among the adjacent *séracs*.

There a few hundred moraine stones and a mass of *débris*, which had rested on a surface tilted up at a steep angle, suddenly commence to move and produce a veritable stony cascade. This is accompanied by a pebbly roar, like that of a receding sea-beach. Now we hear a dull leaden “plump” as a great boulder falls to the bottom of an icy well, there to remain for centuries, but at last to find itself deposited with extreme tenderness—as if it were a living child—on the rocky bed of the infant river.

It would be no exaggeration to say that, with a bright sun, not a single second passes without our hearing a noise, sharp and percussive, rumbling or rolling. The demolition of the glacial structure, indeed, is accompanied by sounds not unlike those

ITS MILLION TON MASS

heard in the demolition of a house or other brick structure. Single stones fall like single bricks, ice walls collapse, fall, and break up like brick walls, *chutes* of stones and *detritus* are as frequent and long as shoots of brick, plaster, and *débris*. The only things wanting—but not wanted—are the clouds of dust.

Merging with these spasmodic and intermittent reports and noises are the weird, impressive glacial groanings. These



LXXV.*

arise from various causes, chiefly the tearing open of crevasses, the squeezing together of them, and the terrific grinding of the vast mass, moving slowly, but with such irresistible force that with it its restraining rocks—by sheer weight of its million-ton mass—

must perforce groan

and give way. These ceaseless moanings of the melting glacier have been likened to the unrest, the groaning “voice of pain,” of souls unsanctified.

* The photograph shows a *sérac* of the glacier surface, with a guide ascending; a profound crevasse to his right hand, and a shallower one to his left.

CEASELESS GROANINGS

“ The mountains have a peace which none disturb,
The stars and clouds a course which none restrain,
The wild sea-waves rejoice without a curb,
And rest without a passion ; but the chain
Of Death* upon this ghastly cliff and chasm
Is broken evermore, to bind again†
Nor lulls nor looses. Hark ! a voice of pain
Suddenly silenced ; a quick, passing spasm,
That startles rest, but grants not liberty ;
A shudder, or a struggle, or a cry,
And then sepulchral stillness. Look on us,
God, who hast given these hills their place of pride,
If Death’s captivity be sleepless thus
For those who sink to it unsanctified !”

Thus does Ruskin refer to the ceaseless groanings of the huge, apparently motionless, glacial masses. Long, however, before his pensive and imaginative mind had been directed to the subject, the simple minds of the mountaineers and *Thal* dwellers peopled the *Gletschers*, not only with souls in anguish, but with fays and fairies in a no less unenviable condition of mind. It is, indeed, not at all to be wondered at that in the old romantic days—when spirits played so great a rôle—these fairy-like palaces and subterranean habitations of crystal should have been peopled, should have boasted their “ice-queens,” who, surrounded by their “glacier-maidens,” reigned over the immense glacier realm.

* The fetters of frost.

† The crevasses oftentimes gape, but to be closed again, and, regelation ensuing, become once more a solid icy mass.

GLETSCHER MYTHS

Is it a matter for surprise, then, that, of old, the simple-minded and pious peasant folk of such parts regarded these wondrous rivers of ice as a fitting abode for souls in need of purification? And how beautiful and delicately conceived are the myths connected with the great glaciers of their valleys!

Here upon the *Gletscher** so many souls were reported to have been hidden in suffering that it was impossible to set foot upon its surface without treading on their heads. Here it was that two beautiful women were seen, one sitting naked on the glacier combing her golden hair in the sun, and weeping bitterly because she must still be frozen in up to the neck nine times before her release could be effected, while the other, although frozen in, sang in a voice of joyful melody at the prospect of her speedy deliverance. Here was the abode of the lovely and light-hearted Emma, who went every year, on the four quarter-days, to the dance of the dead with her companions. From this glacier the unhappy souls came to the cottage of the pious Schmidja to warm themselves. Here dwelt the Lachergeist and the water-nymph of the Massachin, and here appeared the sturdy herd-boy who vanquished the tyrant Urnafas of Naters. Here were the villages from which fifteen elders in mantles and twenty-five bridesmaids dressed in white garments went to Naters on Corpus Christi day. Pages,

* The *Gletscher* of the Rhone.

EMBLEMATIC OF PURITY

indeed, might be filled by the mere recital of such pretty and harmless *sagen*.

If we ourselves do not to-day people the cold glacier caves and crevasses with such ethereal, mythic phantoms, surely we should not be guilty of an inapposite symbolism were we to say that these vast watery masses held rigid in the steel grip of Frost's mighty grasp were emblematic of purity. Go into the wondrous azure icy caverns a hundred feet below the surface, where one is nothing less than bewildered by the strange blue brilliancy, the unnatural bright blue haze, as it were—where, as one essays to steady one's self with a hand on the icy wall, translucent and polished like the purest crystal, the mere warmth of one's hand liquefies it, and whispers that, ponderous though it is, it is nevertheless transient—ay, evanescent; walk over its snow-white surface, gleaming, as Ruskin says, with "that translucent light which we could not have conceived if we had not seen"—a whiteness surely purity itself; peer down into one of its thousand crevasses, which, beginning at their lips in snowy whiteness, gradually increase in depth of tint, first of entrancing, ethereal blue to deep, sombre azure, and in their soundless depths to sable, icy obscurity—all this we see without one sullyng speck of dirt or matter foreign to its body; look carefully across its vast extent of virgin whiteness free from all *detritus*, yet margined with rugged moraines of

EMBLEMATIC OF PURITY

rocky *débris*—of lithic dirt—as if it scorned to bear such disfigurement upon its white bosom, and had thrust it to either side, like the prows of a noble vessel clearing away the sea-tangle from the fair face of the ocean; lastly, examine and drink of the limpid, icy waters to which it gives birth, the purity of the clouds super-purified by arctic congelation. Look carefully at all these things, and reflect if the huge groaning, slowly-creeping glacier be not the emblem of purity.*

Although not of stillness and silence, the surface of a gigantic glacier is a place of awe-inspiring solitude. It is a sight which absorbs our whole attention, and invites us to linger on. For do

* Ruthless bacteriologists destroy one by one our fondest illusions. Now faith in the purity of glaciers must go the way of other popular fallacies. Hitherto the man in the street had imagined that, were all the waters of every city and plain polluted, he would still find immaculate springs in the Alps. But M. Binst, of the chemical laboratory at the Pasteur Institute, having no such faith, obtained some ice from the glaciers of Mont Blanc itself, and placed it under his pitiless microscope. His verdict shatters the dreams of mountaineers. It appears that even the summit, which so long remained untrodden by human foot, has lost its purity, if it ever had any. The ice in question and water melted therefrom were found, on bacteriological analysis, to be "peopled with colonies of microbes." And the germs were found "to belong to the most varied families of bacteria." M. Binst accounts for the pollution of the Mont Blanc glaciers by surmising that the microbes have been conveyed to the mountain-peaks by the winds sweeping the cities in the valleys.

GLACIAL DISMEMBERMENT

we not see great towers and pinnacles of pure, blue-white crystal ice becoming more and more isolated, becoming more and more alienated from their companions, more and more dependent upon their own position, and that, as we can see, an unstable one?



LXXVI.

They must, sooner or later, come crashing down with a speed and a thunder we would fain be there to see and hear. Yet the glorious uncertainty of glacial dismemberment is not unlike that of life itself. That slender, strengthless, tall, bowed icy body there seems to have but few more hours to live; we watch, expecting its sudden collapse, little think-

GLACIAL DISMEMBERMENT

ing that the great mass by its side, which we had quite looked upon as its support, considering it possessed of a foundation and a strength capable of defying for long the melting power of time, would suddenly and without warning have moved off by reason of an undetected fissure ; and before we have time to appreciate what is happening the icy vault has closed over it. Yet there stands the weakly one as before ; another sun has set, the chill



LXXVII.

night wind has braced, regaled, and strengthened him, and the morrow's sun again illumines him among his fellows, whilst his stronger, apparently more robust brother lies below a shapeless mass—forgotten. A glorious sensation it is, and a novel, to sit bathed in a warm sun beside

this frozen sea of arctic coldness. Well might we sit and ponder on.

If, however, we cast romance aside and recall the work of philosophers who have thus stood and pondered, we shall, in looking down upon the tortuous form of the python glacier, be able to evolve order and regularity even out of the chaos of its myriad "horrent spines." E'en these tossing billows we shall find to bear relations to the rocky shores, to range themselves at angles, for which reasons can be

GLACIAL MOTION

assigned. Those clefts—here narrow and sinuous, there wide and profound—are all amenable to existing forces, all referable to recognised laws.

Had we not been told we should not have suspected that million-ton mass, apparently so inert, capable of bodily movement; yet we now know it is slowly but surely streaming past us, and, like a river, flowing more quickly at the centre, more sluggishly at its sides. A mere cursory glance will suffice to teach us that even the rocky *detritus*—the dirt, as some call it—is arranged upon its chill surface in law and order. Look at the regularly piled heaps of rock and shingle at either side, look at the regular but sinuous streak of dark-brown lithic frag-



LXXVIII.

ments marking out the centre* of the lovely ice-way, for as Tyndall has said: "The surface of the glacier does not long retain the shining whiteness of the snow from which it is derived. It is flanked by mountains which are washed by rain, dislocated by frost, riven by lightning, traversed by avalanches, and swept by storms.

* See medial moraines in Appendix.

GLACIAL BURTHENS

The lighter *débris* is scattered by the winds far and wide over the glacier, sullyng the purity of its surface. Loose shingle rattles at intervals down the sides of the mountains, and falls upon the ice where it touches the rocks. Large blocks are continually let loose, which come jumping from ledge to ledge, the cohesion of some being proof against the shocks which they experience, while others when they hit the rocks burst like bomb-shells, and shower their fragments upon the-ice.

“Thus the glacier is incessantly loaded along its borders with the ruins of the mountains which limit it, and it is evident the quantity of rock and rubbish thus cast upon the glacier depends upon the character of the adjacent mountains. Where the summits are bare and friable, we may expect copious showers; where they are resistant, and particularly where they are protected by a covering of ice and snow, the quantity will be small. As the glacier moves downward it carries with it the load thus deposited upon it.”

Some of the rocks which thus find themselves upon the glacier are of enormous size, and the presence of such large and isolated masses gives rise to phenomena which in turn give rise to inexpressible surprise upon the part of casual mountaineers. We refer to the *glacier tables*—tables formed of huge rocks supported high upon a stem of ice.

What happens is this: The great stone imbibes

GLACIER TABLES

heat from the sun and radiates it out again all around, except beneath, for the sun will only have warmed the surface of the stone. Thus the ice around becomes melted and flows away. Day by day the annular space thus formed increases in ex-



LXXIX.

tent, until we see the stone, or table-top, reared aloft above our heads. But where is the growth of the ice-stem to end? In Nature there is always a counteracting force. The south side of this raised stone naturally gets hotter than the north, so that after thus raising itself up it begins to melt the ice more on one side than on the other. It gradually loses its horizontal poise, and at length becomes tilted at such an angle that it slides off its pedestal to the ice below; but there, undaunted, as it were, it immediately starts building itself up on to a table again.



LXXX.

Stones carried down by former glaciers are found in most out-of-the-way positions and places, and are generally known as *blocs erratiques*.* Some of these are of enormous size; as instances we may mention the "Ploughstone," which is 60 feet in height and

* See "Fragments of Continental Journeyings," by the Author.

ERRATIC BLOCKS

contains some 72,000 cubic feet, and another, an enormous mass of serpentine rock, whose cubic contents are some 240,000 feet.

One of these enormous lithic fragments—these erratic blocks—is shown in our photograph upon the opposite page. Standing beside it as it lies to-day, quiescent, silent, inert, feeling the while as insignificant as the tourist there appears, we scarcely appreciate how powerfully it has spoken, what



LXXXI.

lectures it has delivered. Yet it and its *confrères* have taught us much—and most impressively — of the giant works achieved by Nature's glacial masons, whose labours have long since ceased. Written upon its substance it has brought a faithful message of the place whence it set out upon its frigid chariot to perform

its lengthy journey, deliberate but majestic, little dreaming that its sluggish peregrinations would be known to us to-day, thousands of years after it had been so carefully set down on Mother Earth, whose touch for long centuries it had not known.

Not only are the journeyings of these interesting erratic blocks known, but maps have been laboriously prepared of their present positions and the work of

GLACIAL TRANSPORT

the masonic carriers recorded. Of similar but gruesome interest are considerations of these icy transports as funeral biers, for so carefully have their precessions been studied that, when human beings find a premature sepulchre within their chill cracks and caverns, a calculation of tolerable exactitude can be made as to the date at which the icy grip



LXXXII.

shall be relaxed, the day when the glacial python shall deliver up its dead.

“ There are no natural objects out of which more can be learned than out of stones. They seem to have been created especially to reward a patient observer. Nearly all other objects in Nature can be seen to some extent without patience, and are

SERMONS IN STONES

pleasant even in being half seen. Trees, clouds, and rivers are enjoyable, even by the careless; but the stone under his foot has, for carelessness, nothing in it but stumbling; no pleasure is languidly to be had out of it, nor food, nor good of any kind—nothing but symbolism of the hard heart and the unfatherly gift. And yet, do but give it some reverence and watchfulness, and there is bread



LXXXIII.†

of thought in it more than in any other lowly feature of all the landscape; for a stone, when it is examined, will be found a mountain in miniature.”*

We would again call the reader's attention to the gigantic erratic block shown in our photograph, the enormous size of which is gleaned by

comparison with the tall man standing beside it. Now, if we compare this with the fallen boulder shown in another photograph,‡ we shall at once see that all

* Ruskin.

† From Dr. H. Smith Williams' "Nineteenth-Century Science," by the courtesy of Messrs. Harper and Bros.

‡ See photograph I.

GLACIAL SCRATCHES

its asperities—all its sharply fractured edges—have disappeared, telling us of many a tumble, many a roll it has sustained whilst being carried along upon its glacial cradle, many a harsh grinding against the rocky mountain-sides. It is, as we see, nicely “rounded over,” but so is the stone illustrated upon the opposite page! However, that is “rounded over” from a very different cause, for it is a meteoric stone. It has been rendered white-hot—incandescent, nay partially melted—by its flight, at incredible speed, through our atmosphere.

More carefully rounded over still and beautifully polished is the stone reproduced here,* and this, again, for another reason: for

this has lain upon the bed *beneath* a glacier, and we see how, whilst being polished, it has also been mercilessly yet so interestingly scratched by the superincumbent icy leviathan gliding along above it.

Often, standing on or near a glacier, we hear a



LXXXIV.

* By the courtesy of Lord Avebury.

CREVASSES

series of sharp cracks beneath the ice, just like a salvo of musketry. Carefully looking for the cause, we notice that a crack has occurred in the floe not wider than our hand. This soon, however, widens out, and we get a crevasse formed. These crevasses are common on all glaciers ; they vary in width from a few inches to many feet ; similarly, they are often many feet deep, 50 to 60 feet being quite a usual depth.

Their form is most beautiful : the ice at their sides is jagged and rugged ; torn asunder by great force, the sides have taken the most fantastic shapes. The ice is usually of pure blue colour, and is seen to best advantage if one enters one of these crevasses, but the cold is intense and the darkness repellent if we venture too far. One can scarcely find beauty enough in the azure shimmer of the walls to make up for the loss of the glorious white sunlight without.

Nothing can be more terrible than to fall into one of these crevasses whilst crossing a glacier, especially if efficient aid be not at hand. Death comes to one in an awful form ; gradually the body sinks from its natural heat, and blood and life is frozen up within one till darkness everlasting—impenetrable as the hard walls of the prison—has settled on our earthly gaze for aye.

We once heard of a lady who fell into one of these crevasses, and, well knowing of what vital importance it was to keep warm until help could reach her from the efforts of her friends above, she started to undo and do up her hair an innumerable number

SNOW BRIDGES

of times, and by thus working kept her arms and body in motion. The heat generated by the work happily kept her warm enough to ward off the deadly drowsiness, which must have ended in death, until aid was brought her and she was rescued from her icy prison—her almost grave.

Often flung across these perilous crevasses are natural bridges of snow; perfect arches formed across their yawning chasm. These are often but 15 to 20 inches wide and but 2 or 3 feet through in the equivalent to their *voussoirs*, yet sometimes they are massive structures. But, small or large, your Alpine guide will readily lead you across them, and “creepy” though the passage may be, it is often the only method of getting to the other side of a large crevasse.*

The surface ice of a glacier, constantly exposed to the sun, naturally thaws considerably during the day; this water collects in little rills, which join to form rivulets and often fair-sized streams, rushing over the smooth ice of the glacier, cutting out their bed as they go; but when they meet with a crevasse they plunge bodily down into the abyss below. Should there be no crevasse in their course, there arises another phenomenon of the glacier, called the *moulin*. The stream of water finds a weak spot in the ice and cuts its way in; a crack occurs, and down that crack the water rushes and forms an

* See Appendix.

MOULINS

opening, which apparently swallows up the stream. This is the *moulin*. But the movement of the glacier tends to squeeze together its sides ; then if these recongeal the river cuts out a new *moulin* behind the old one. Sometimes this happens even without the closing of the first opening, and in places we see four or five of these abandoned moulins stretching one in front of the other, and all in front of the opening down which the water is actually pouring. These are very deep—in fact, probably extend right through the ice to the bed over which the glacier is flowing. Tyndall measured one with a plumb-line, and found it 60 feet deep ; while on another occasion, measuring by the sound made by a falling stone, he calculated that an especially large moulin was about 345 feet in depth.

The water so carried down beneath the ice runs along underneath the glacier until it reaches the head of the valley, where the ice has been for the most part melted. Then the water bursts into view from beneath, and, forming a turbulent stream, helps to thoroughly break up all that is left of the ice originally formed high up above the snow-line.

In examining these huge blocks of glacial ice it is difficult to recognise in them metamorphosed *névé* or snow—snow which, as we have said, fell as flocculently upon the summits as in the lowlands. Yet if experimented with it will be found that glacial ice differs much from ordinary ice. For example, if we

GLACIER CAVERNS

place a piece of ordinary* ice upon a plate and allow it to thaw, it will merely dissolve into water. Not so the glacial ice! This will gradually break up into irregular crystals. Various reasons have been ascribed for this behaviour, but we believe the correct one—which has not been touched upon—to be that the ice still retains within it much of the air originally imprisoned in the interstices of the snow, such air, however, being reduced to imperceptible volume by the enormous pressure to which it has been subjected; yet, being compressed, this same air still strives to expand to its original volume, and as soon as the expansion is able to overbalance the cohesion of the mass the ice breaks up into fragments in this remarkable fashion.

One of the splendours of the glaciers are their caverns. These are both natural and artificial, the latter, cut usually near the face of the glacier, being visited by thousands. Words are quite powerless to convey any impression of the lovely blue suffusing the interiors of these little ice-palaces. Leaving the surface they are bluish-white, then we are in a soft and lovely azure haze, as it were; proceeding farther, this deepens to deep blue, e'en to ultramarine.

Beauteous are the caverns and crevasses of the giant *gletscher*, whilst its surface, so weird, so wild—the stricken river, so difficult to cross, so dangerous, so all-engulfing—and the motionless billows, so colossal,

* See Appendix.

FRIGID LAVA

so severe, so solemn, arouse awed admiration within us. The slow and measured precession of its chill and all-o'ercoming weighty body not only carves valleys out of mountains, but deals destruction to its own erstwhile placid surface. For as the white coverlet transmutes from flocculence to *firn* and *névé* it cements, in frigid embrace, the rocky pinnacles and lithic excrescences of the mountain summit with a pavement smooth, undulating, and of kindly contour,



LXXXV.

as if the mountain headlands had been cast in a setting of hard white lava—a setting so firm, so rigid, that one would think nought could fracture it.

“Many a mickle maketh muckle,” say the Scotch. How well exemplified here! What could be lighter than the feather-like snow silently falling? What less weighty than the flocculent flake? Yet many a million weigh so much that the immense pavement as we see it in our photograph is forced to move

GLACIAL FRACTURE

onwards in its rock-hemmed channel. Now, if this rocky channel were, like a man-cut canal, straight and of even grade, the supernatant snow would doubtless propel the leviathan downwards and forwards like a ship sliding in its stocks. But the cleft is far from straight; it is beautifully irregular both as to its edges and its flooring, and hence the mighty body, though pliant beyond our expectation,*



LXXXVI.

is fractured, and gashed, and crevassed. Does the earthquake-born fissure turn brusquely? there are the crevasses spreading like a fan. Does it turn to the other hand? there is the glissant *pavé*, gaping here and closing there. Does the rocky bottom here evince an abrupt step or fall, there above it is the 'ice fall,' the frigid body transversely sliced, its *laminæ* opening like a purse, a book, or a pack of cards, as

* See Appendix.

GLACIAL STREAMING

we see them in our photograph; lastly, when the mighty mass shall have arrived down in the valley, there do its icy leaves bend forwards, shedding before them the stones and boulders they have so silently borne upon their edges, and prostrate their chill translucent forms before their master, the potent



LXXXVII.

sun, who had bred them and placed them in infancy in their mountain-hung cradle, there to sacrifice their being at the altar of eternal change. Thus pass away the "horrent spines," the snowy billows, the frost-arrested waves, the icy peaks and pinnacles—chill, giant monuments, massy but transient—such as we see in our photograph, such as filled us with joyous admiration when far up upon the heaving bosom of the awful *gletscher*.

Not only is it known that glaciers move, but their rate of progress has been carefully measured, one of the most interesting features of such investigations being that when a line of staves has been planted transversely across a *glacier*—in a *perfectly straight* line—such row of stakes will in process of time assume a *curve*, by reason of the central or medial

GLACIAL STREAMING

portions of the ice stream travelling more rapidly than those portions more contiguous to the sides or shores, just as, if we cast a number of pieces of wood simultaneously from a bridge into a river, we should find those that fell upon it near its centre would quickly outstrip those at the sides, all floating seawards in a curved configuration.

Nevertheless, so slow is the motion of these great ice rivers that it is not made evident to either of our senses—as so prepollently does the fleet movement of aqueous rivers—that glaciers are also Dame Nature's masons. True, the sculptured work of those that have passed away is to be seen by us in all directions, and we also see that e'en the one upon which we stand is bearing valleywards thousand-ton burthens of the "everlasting" rock from far above; but because the glacier is one of Nature's most silent workmen he is apt to be credited with less than his share of sculptural work.

The glacier slides slowly yet irresistibly downward, like a vast leviathan, and we were anxious to know if in so doing its great cold body became deeply scored by the hard and projecting rock. We accordingly lowered ourselves down some distance between it and its rocky bed, and found our surmise to be verified. There were the deep ruts, the great projecting ribs, like those upon a boat, and deeming it an interesting feature, we took down a camera and essayed to photograph, but unhappily the light

SUBGLACIAL LAKES

there was insufficient to enable us to get a picture of it fit for reproduction for the reader.

Although we may not be able to appreciate the work being done by the solidified water, the gurglings and rushings of the liquefied snow tell of its return to earth.

Usually the water makes its way by ice cranny and crevasse down into the valley, but it sometimes happens that it becomes so entrapped as to form large *accumulations* or *subglacial* lakes. Normally, such subglacial lakes discharge their superabundant volume by overflow, but their waters may become so hemmed in that—assuming proportions and weight the ice is incapable of withstanding—they burst their frigid confines and give rise to dire catastrophe. Such a one, the bursting of the glacial lake of Derborensa in 1749, is thus spoken of by a contemporary writer :

“It overwhelmed forty châteaux and a large area of pasture-land. In a saw-mill lower down five workmen were killed, but the herdsmen fled betimes with their cattle, warned by a long-continued crashing and crackling which seemed to proceed from the interior of the mountain. Still earlier (in 1714, September 25 and the following days) great masses of rock had fallen from the Diablerets, burying fifteen men with their herds and huts. Large blocks were hurled as far as the opposite side of the valley. One man, George Oder of Aveu, had a

SUBGLACIAL LAKES

wonderful escape. A large block came to a standstill immediately before his hut, and sheltered it in such a manner that, though buried, it was not crushed by the *débris* that followed. Three long months did the poor fellow remain in this tomb; water trickling in through a crevice gave him some hope of finding an exit. Living on the provisions stored in his little cabin, he toiled constantly to dig a passage through the *débris*, till at last he succeeded in escaping from his dark prison into the light of day. It was Christmas-time, and the snow lay thick around him. He managed to drag himself as far as Aveu, but his appearance was so frightful that everyone took him for a ghost. Only after a priest had been fetched to exorcise him was he able to persuade the people that he was George Oder, still in the flesh. He lived, however, but a short time afterwards."

Of all the glaciers we visited among the Alps we thought none more beautiful than the *Aletsch Glacier*,* of which we give photographs.† This is situated on the side of the *Aletschhorn* (13,720 feet); and displays a most uncommon phenomenon, for many thousand years ago a branch of this glacier scooped out a lake basin as it flowed towards the valley. In this at later date the blue ice became transformed into beauteous blue water, a firmament below one's

* Conveniently reached from the Bel Alp.

† See LXXII. and LXXVIII. and LXXXVIII.

THE ALETSCHE GLACIER

feet as purely azure as the one above. Thus arose the *Mörjelensee*, a lonely lake situated high in the solitude of the mountain crests.

The present Aletsch glacier bounds one side of this expanse of water, rising as a wall of pure blue ice some sixty feet above the still bluer lake. This juxtaposition of *gletscher* and lake gives rise to strange phenomena, for the water undermines the



LXXXVIII.

ice so that, like a roof, it projects far out above the lake, until, unable to support its own weight, the ice of the glacier breaks off in great blocks and shales away in vast masses into the water.

These detached bodies become veritable icebergs floating in the pure blue water, and by reflection of the sunlight from their surfaces look dazzling white,

THE MÖRJELENSEE

whilst mirrored in the still water is the reflection of each berg, so faithfully that the ice-masses appear doubled. The hollow which holds the *Mörjelsee* is no less than some thousand feet in length and a third of that in breadth. Its basin is thus formed partly by the towering rocks and partly by the translucent walls formed of the *gletscher's* icy mass, a veritable ice-cliff. The aspect of this chilly lake thus restrained is as impressive as it is unusual. On the surface of its deep blue waters the huge blocks of white ice float like mammoth swans, whilst its waves ever and anon break in foam against the glassy emerald-green walls of the mother glacier which gave them birth. The peculiarity of the glacier lies in the fact that, in spite of glacial motion, its body fails to entirely fill the rocky hollow.

The extraordinary fact has long been known that this lake, named after the pastures of *Mörjelen*, empties itself periodically.* According to popular belief this takes place every seven years, but it last happened in 1878 and 1884. Within two or three days the enormous volume of water, amounting to about 350,000,000 cubic feet, finds its way through the glacier, and, as reported by the herdsmen, causes a terrific cracking, crashing, and snapping among the fissures and narrow icy vaults. The angry and tumultuous waters pour violently through

* See Appendix.

ITS DISAPPEARANCE

the chasms of the glacier, overflow the lower parts of the Valley of the Rhone, and occasion extensive floods, terrifying and distressing the people of the Valais. A few pools of water in the hollows of the sandy bottom alone remain as evidence of the vanished lake, and the blocks of ice, robbed of their former splendour, lie high and dry, like derelict vessels.

With these few words concerning glaciers we have trodden the crisp dry *firn* of their summits, descended upon their vast snake-like bodies, and scaled their acute *séracs*, where *crevasse* and *moraine* speak to us of their motion and sculpturing work, whilst their chill rivulets whisper to us of their transience.

Keeping company with its frigid body, we descend to the valley head—yet we are still 5,775 feet above sea-level—only to find laid out before us a great expanse of stony boulders, chips from its silent chisellings. Here we can easily see that besides depositing the summit snow in the valleys, and thus returning to earth the water the sun has raised up from it, these glaciers are always grooving out the sides of the mountains down which they slide. They carve out the rocks, they scoop away the earth, carrying all downwards into the valleys.

Clambering over the rocky boulders, noting their rounded nature, and pondering upon the centuries some of them may have been embedded within the icy body of the now defunct *gletscher*, we find our-

THE RIVER'S BIRTH

selves jumping numerous streamlets, whilst the sound of the nascent river becomes louder and louder as we approach the central portion of the glacial tongue.

We now look up in admiration of its vast mass. There it lies like some colossal, bloodless monster, whose body is hidden from us by those grand peaks, but whose thrust-out tongue, covered with a gray, deeply-fissured "fur," reaches to our feet—a giant gnome's tongue. We look at its very point, where at the centre is a little indentation like that upon the pink tongue of the noble St. Bernard looking up at us. In both cases clear crystal "dew" is slowly disengaging itself.

That dew in the former case is the infant river,* and it laughs to be set free from the icy mass. As it runs by over its stony bed it utters a gentle murmur—a birth-cry—but so small a voice is it it would have no chance of being heard by its mother in the roaring it is itself to make as it gets older.

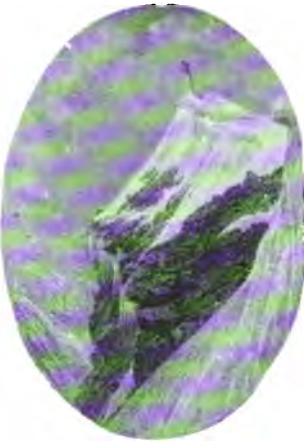
Centuries ago the river did not see the light of day, nor gain its liberty so soon by long, long years of incubation. *Enceinte* in an icy womb, it was carried a hundred miles further down, and we can to-day in the most unmistakable and entrancingly interesting manner trace the indentations and scorings of the maternal hips as they were forced groaning between the hard, unyielding, rocky child.

* The Rhone.

THE RIVER'S YOUTH

bed sides. To this day the *débris* still lies thickly on the valley margins.

To-day the newly-born stream goes dancing through the chasm, as if it knew its youth was to be spent in a beautiful sunny vale, where it will be petted, tended, and watched over by angling nurses, who will talk learnedly of its moods, and will from



LXXXIX.

time to time eagerly yet affectionately "whip" it, and dangle across its sparkling face the gorgeous, lifelike fly, that they may catch of the myriad finny denizens it is destined itself to nurture.

Then for a time it will conceal itself, and, playing hide-and-seek, glide through the silent expanse of the sleeping lake, again, however, to show the vigour of

its youth as it escapes and hastens through crowded streets, dealing out cuffs and thrusts—striking fire enough to light the whole town,* and to carry about its inhabitants on the strong, swift shoulders of "Electron."† There will it lavish immense strength and yet not miss it, for it will hasten on to raise its loud voice on the stony beds of other cities; and yet on again, now sullied by the

* Geneva.

† All the electric tramcars are driven by it.

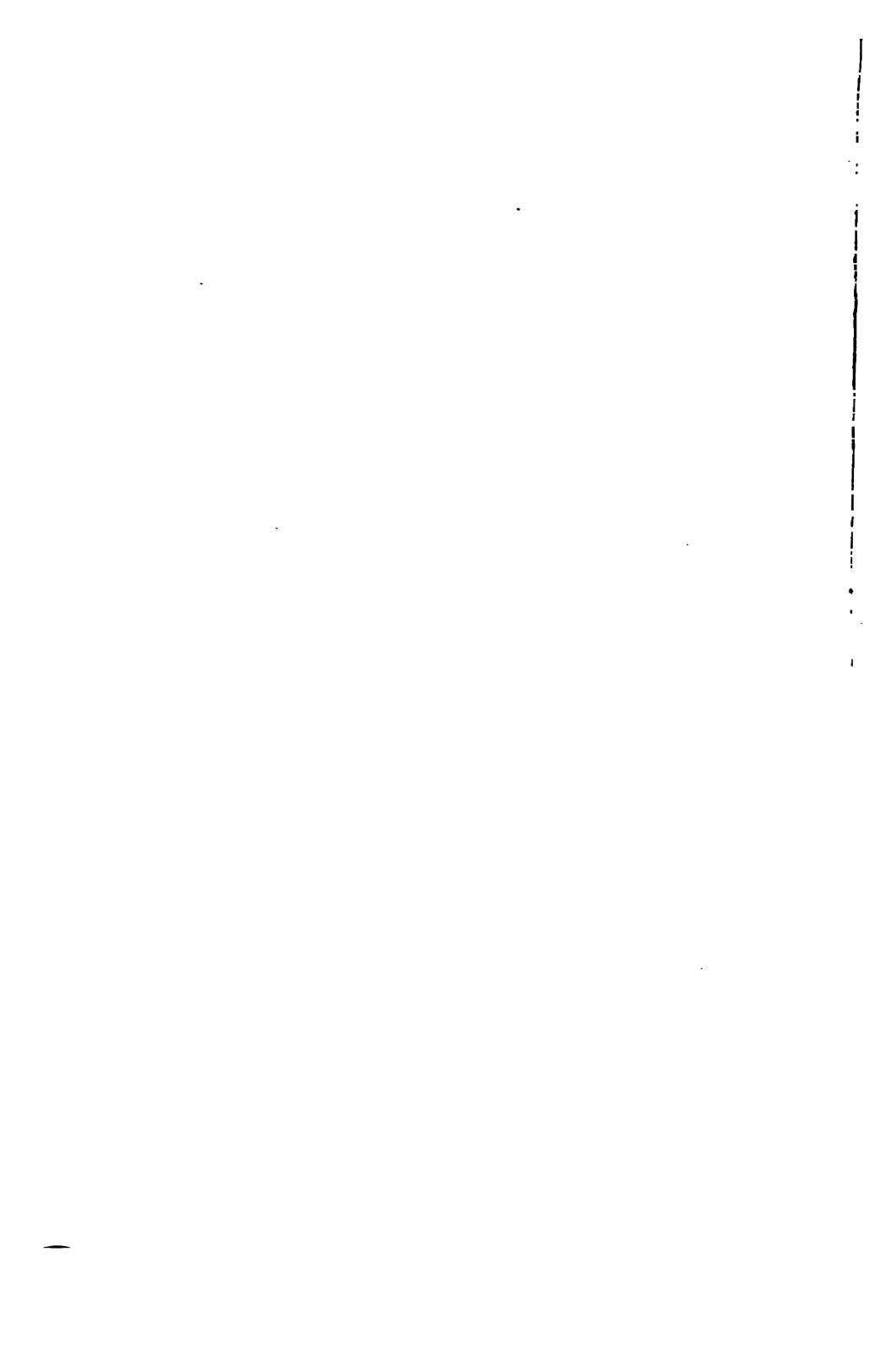
THE RIVER'S DEATH

dregs of a dozen towns, to a noisy, hot, odorous maritime port. There will it be disillusioned ; there will its blissful ignorance be broken in upon ; there must it take upon its mature shoulders the burthen of thousand-ton ships ; there, befouled and weary, will the land of its birth cast it off, vouchsafing it but a tranquil burial in the limitless ocean, as if it were a mortal disembodied and cast upon the undefined ocean of soul.

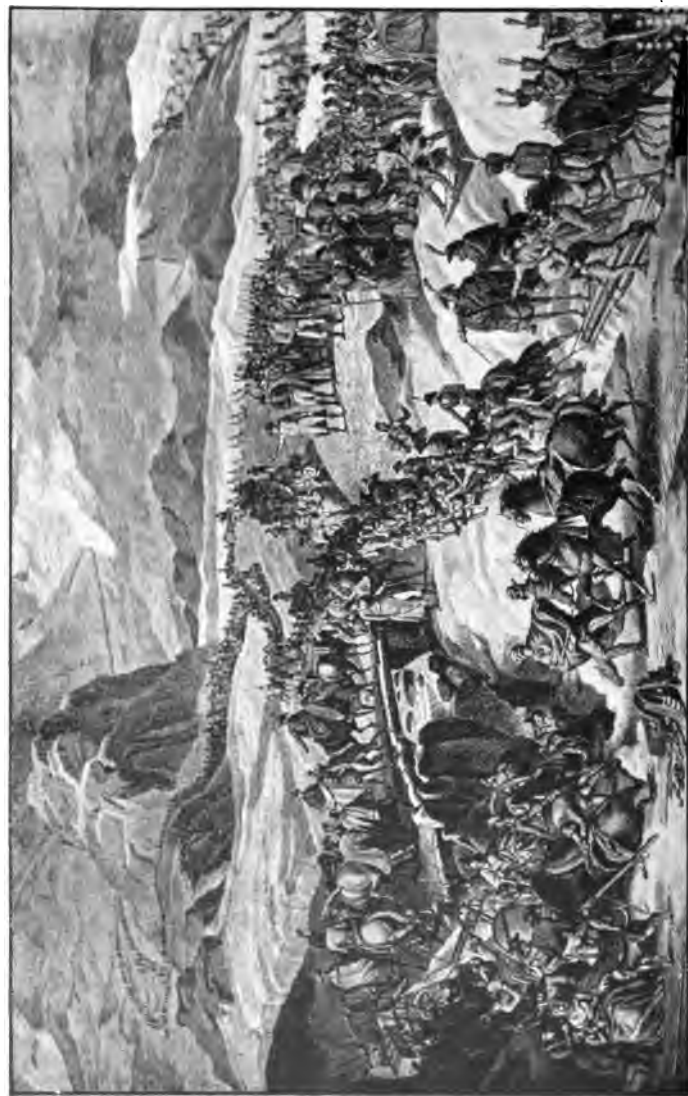
Well is it indeed for us poor mortals that we, like the blue and youthful river, are kept in happy ignorance of the burthens life's progress has in store for us ; well, indeed, is it also for the happy sheep we see contentedly cropping the green herbage by its banks that they, too, know not of the cruel and ignominious end awaiting them.

The decease of the glacier is the birth of the river ! The end of the river is the ocean ! Advent of that entrancing cycle of Dame Nature, which createth cloudland, spreadeth the snow upon the mountains, maketh the bounding waterfall, buildeth up the frigid glacier, carveth the face of Nature, brimwith the flowing river, thus fleetly returning to the maternal bosom, the ocean—greatest of all Dame Nature's masons.

NOTE.—For some of the originals from which illustrations in this chapter have been prepared we are indebted to Mr. Edward Whymper, whose skill with his pencil as well as his pen in his descriptive Alpine Guides is so well known.



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To face Chap. V.

THE PASS IN 1800.

CHAPTER V

THE PASS

“ . . . We would go
To the dread summit of the Queen
Of mountains, through a deep ravine
Where in her holy chapel dwells
‘ Our Lady of the Snow.’ ”



xc.

THE cyclist, finding himself in Alpine St. Pierre, and not desiring to pass on into Italy, but only to pay a visit to the Hospice of St. Bernard, would do well to leave his cycle here. In either case the polite and little-to-do officer of the *douane* will be sure to want a little conversation with him, and therefore he must make up his mind which he elects to do ; for if he leave his mount here, it will not be necessary for him to go through the Customs formalities. Although the *bureau de la douane* is here in St. Pierre, the frontier is on the top of the pass ; but in common humanity, and for other reasons, the Italians have refrained from

EARLY TRAVELLERS

posting the old fellow on the tempestuous and lonesome heights.

Should the cyclist be going down into Italy with his mount, he must prepare himself for a rough walk down from the Hospice, for there is no road, but merely a very steep boulder-besprinkled mule-path. He will, however, meet with no further difficulty.*

The Grand St. Bernard being the lowest and easiest of the Alpine frontier passes, we should expect to find that it was the first to be used as a means of getting from country to country. When it was first discovered or used one cannot say; but we know that it formed the passage for quite a number of invasions of Italy by Celts, whilst early missionaries crossed it, carrying with them primitive Christianity.† During the tenth century it was the abode of Saracenic robbers, who plundered merchants and their caravans, and held high dignitaries of the Church to ransom. In medieval times German Emperors used the pass on several occasions, and Roman legions crossed it to invade Gaul, so that even many centuries ago it was crossed by large bodies of men.

To-day, indeed, as we look out on the old street, we are reminded of the crossing of the Roman legions by the presence on the old church wall, near

* Since the above was written, we understand a mountain-road has been cut.

† The Alps were crossed by numerous bodies of Goths invading Italy in the autumn of the year 408.

NAPOLEON'S VIEW

its tower there, of a Roman milestone. The old sundial, too, in the ancient church tower reminds one that it had weathered many an Alpine winter before Galileo had thought of the pendulum or the first clock had been constructed. The old church is still maintained by the monastery of St. Bernard. One notices another sundial on the wall of the little hotel, and on the south side of the village traces of some old fortifications with an ancient gateway.

In visiting the *Linnæa*, as we stand on the eastern edge of the little monticle, we see a bridge. This is said to have been constructed by Charlemagne in the year 750. It is, moreover, the one passed by Napoleon and his army on May 21, 1800, the first of six days of enormous difficulty and arduous exertion for his officers and men, numbering over 30,000. For :

“The Corsican, intent his foe to crush,
A highway here for all the world did form ;
But from the north fierce Boreas doth rush,
His weapons snow, and avalanche, and storm ;
These in his potent grasp he threat'ning shakes,
In winter when this way the wanderer takes.”*

A little beyond it are the ruins of a fortress, also built by Charlemagne. Over a thousand years later the great commander and master of the tactics of modern war would, no doubt, have liked to have met his enemies here where we stand, and have

* L. L. von Roten.

MONT MORT

spared his men the hardships and losses of the ascent ; but he was powerless to bring that about. We have his opinion of mountain warfare :

*“ Dans la guerre de montagne, il faut se faire attaquer et ne jamais attaquer ; c'est le contraire en plaine.”**

Looking eastwards, also, we see the *Cascade de Valsorey*, and above it the *Aiguilles* of the same name. To the right of the falls is Mont Velan (3,765 feet) with his cap of eternal snow, whilst at the end of the gorge, westwards, we have the Mont Mort—a solemn name—on the shoulder of which we shall presently find the equally solemn Monastery of St. Bernard. The mountain to the west, again, is the *Mouvin*. From the village one also gets a fine view of Mont Velan, with the valley of the glacier of the Sorey. This quaint little St. Pierre may be made the starting-point for some very interesting mountain excursions, as well as several *col* passes ; indeed, Italy may be reached from here by a *col*, with the aid of a guide, without following the excellent road cut upon the side of St. Bernard. This, however, is by far the more interesting.

“ Brook and road
Are fellow-travellers in this gloomy pass,
And with them do we journey several hours
At a slow step.”

As we start out from the little inn to ascend the

* “ *Maximes de Guerres et Pensées.*”

HANNIBAL'S CROSSING

pass, our thoughts turn to long, long ago, when instead of its being so quiet and so solemn as it is this morning, it was crowded with a vast mass of toiling men and animals during the crossing of the army of that celebrated old-world general, Hannibal. On the death of his brother-in-law Hasdrubal, Hannibal was, with the united voice of his soldiery, chosen their leader. He was then but in his twenty-sixth year, yet he forthwith crossed the Tagus, and in two years reduced all Spain up to the Ebro. This was in B.C. 221. Three years later (B.C. 218) the "war of Hannibal" began—a war to which he had pledged himself before the altar and at his father's behest at nine years of age. During this he made the passage of this pass with his vast army, a crossing which has survived in history as the most momentous ever made. But at what a sacrifice of life!—entailing losses, suffering, privations, if not courage, surpassing all modern repetitions.

Setting out for Rome, he was at the head of a vast army—90,000 foot, 12,000 horses, and 37 elephants; and with them he commenced the ascent. But such were the almost incomprehensible difficulties of this Alpine march that fifteen days of war with Nature as well as with man were opposed to his indomitable will—fifteen days' courageous warring with obstacles such as would have daunted all other generals—fifteen days during which his troops, reared 'neath African and Spanish suns, perished 'mid

HANNIBAL'S CROSSING

the snow and ice in their thousands. The native tribes decimated and threatened with annihilation his whole force, and were only dispersed by his matchless courage and address.

His beasts of burden fell over precipices or stuck fast and were frozen to death. His road had to be made as he advanced; rocks had to be shattered and ledges cut to enable his men to creep round projecting crags and precipices.

“Deafening the din, when in barbaric pomp
The Carthaginian on his march to Rome
Entered their fastnesses. Trampling the snows,
The war-horse reared, and the towered elephant
Upturned his trunk into the murky sky,
Then tumbled headlong, swallowed up and lost,
He and his riders.”*

His losses spoke eloquently of his invincible perseverance; for when his men were drawn up on the plain of Aosta,† Hannibal had but little more than one quarter of his men and one half of his horses, and to these was opposed an army of 170,000 unrivalled soldiers.

This great exploit lives in history; but it would appear that the first to force the passage of the Alps with an army were Bellovèse and Sigovèse, sons of a sister of Ambigat, King of the Celtic peoples dwelling between the Seine and the Garonne, who crossed for the purpose of establishing themselves in

* S. Rogers.

† See “A Glimpse of Fair Italia.”

FIGHTING BY THE HOSPICE

Italy, and who are said to have founded Milan, Verona, and several other of the celebrated towns of Lombardy.

Two thousand years and more elapse after the frightful negotiation of the pass by Hannibal and his army, and then the great modern commander, Napoleon, crosses it. In the meantime, however, and closely preceding his exploit, the lonely pass of St. Bernard had been the scene of warrior travail—ay, and of bloodshed—for hundreds of thousands of French and Austrian soldiers crossed in the years 1798 and 1799. In the latter year, indeed, a fierce engagement took place on the pigmy plain under the shadow of Mont Mort, and just beyond the hospice; renewed and renewed as the Austrians endeavoured to force their way past the venerable and sacred building. The French, however, remained masters, and, indeed, garrisoned the hospice for a whole year.

Then ensued, in the following year, the crossing of the Great St. Bernard by Napoleon, illustrative not only of bold resolve and arduous accomplishment, but also of profound tact and resource, for his crossing of the Alps by this pass was but one of three—almost simultaneously executed—trans-Alpine incursions into Italy. Napoleon's objectives, as well as his difficulties, are thus well touched upon:

“The better to hide his purpose he chose as his first base of operations the city of Dijon, whence he

BONAPARTE'S TACTICS

seemed to threaten either the Swabian or the Italian army of his foes. But this was not enough. At the old Burgundian capital he assembled his staff and a few regiments of conscripts in order to mislead the English and Austrian spies, while the fighting battalions were drafted by diverse routes to Geneva or Lausanne. So skilful were the preparations that, in the early days of May, the greater part of his men and stores were near the Lake of Geneva, whence they were easily transferred to the upper valley of the Rhone. In order that he might have a methodical, hard-working coadjutor, he sent Berthier from the office of the Ministry of War, where he had displayed less ability than Bernadotte, to be Commander-in-Chief of the 'Army of Reserve.' In reality Berthier was, as before in Italy and Egypt, Chief of the Staff; but he had the titular dignity of commander, which the Constitution of 1800 forbade the First Consul to assume.

"On May 6 Bonaparte left Paris for Geneva, where he felt the pulse of every movement in both campaigns. At that city, on hearing the report of his General of Engineers, he decided to take the Great St. Bernard route into Italy, as against the Simplon. With redoubled energy he now supervised the thousands of details that were needed to insure success; for, while prone to indulging in grandiose schemes, he revelled in the work which alone could bring them within his grasp, or, as Wellington

THE PASSAGE

once remarked, 'Nothing was too great or too small for his proboscis.' The difficulties of sending a large army over the Great St. Bernard were indeed immense. That pass was chosen because it presented only five leagues of ground impracticable for carriages. But those five leagues tested the utmost powers of the army and of its chief. Marmont, who commanded the artillery, had devised the ingenious plan of taking the cannon from their carriages and placing them in the hollowed-out trunks of pines, so that the trunnions fitting into large notches kept them steady during the ascent over the snow, and the still more difficult descent.* The labour of dragging the guns wore out the peasants; then the troops were invited—a hundred at a time—to take a turn at the ropes, and were exhilarated by martial airs played by the bands or by bugles and drums sounding the charge at the worst places of the ascent. The track sometimes ran along narrow ledges, where a false step meant death, or where avalanches were feared. The elements, however, were propitious, and the losses insignificant.

"This was due to many causes: the ardour of the troops in an enterprise which appealed to French imagination and roused all their activities, the friendliness of the mountaineers, and the organizing powers of Bonaparte and of his staff—all these may

* Thiers attributes this device to Bonaparte, but the First Consul's bulletin of May 24 ascribes it to Marmont and Gassendi.

THE PASSAGE

be cited as elements of success. They present a striking contrast to the march of Hannibal's army over the Alps. His motley host struggled over a long stretch of mountains in the short days of October over unknown paths, in one part swept away by a fall of the cliff, and ever and anon beset by clouds of treacherous Gauls. Seeing that the Carthaginian's difficulties began before he reached the Alps, that he was encumbered by elephants, and that his army was composed of diverse races, held together only by trust in the powers of their chief, his exploit was far more wonderful than that of Bonaparte, which, indeed, more nearly resembles the crossing of the Great St. Bernard by Francis I. in 1515.

“The difference between the conditions of Hannibal's and Bonaparte's enterprises may partly be measured by the time they occupied. Whereas Hannibal's march across the Alps lasted fifteen days, three of which were spent in the miseries of a forced halt amidst the snow, the first Consul's forces took but seven days. Whereas the Carthaginian army was weakened by hunger, the French army carried their full rations of biscuit, and at the head of the pass the monks of the Hospice of Great St. Bernard served out the rations of bread, cheese, and wine which the first Consul had forwarded, and which their own generosity now doubled. The hospitable fathers themselves served at the tables set up in front of the hospice.

NAPOLÉON'S DEPARTMENT

“After insuring the regular succession of troops and stores, Bonaparte himself began the ascent on May 20. He wore the gray overcoat which had already become famous, and his features were fixed in that expression of calm self-possession which he ever maintained in face of difficulty. The melodramatic attitudes of horse and rider, which David has immortalized in his great painting, are, of course, merely symbolical of the genius of military democracy prancing over natural obstacles, and wafted onwards and upwards by the breath of victory. The living figure was remarkable only for stern self-restraint and suppressed excitement; instead of the prancing war-horse limned by David, his beast of burden was a mule led by a peasant; and in place of victory, he had heard that Lannes with the vanguard had found an unexpected obstacle to his descent into Italy. The narrow valley of the Dora Baltea, by which alone they could advance, was well-nigh blocked by the fort of Bard, which was firmly held by a small Austrian garrison, and defied all the efforts of Lanne and Berthier. This was the news that met the First Consul during his ascent, and again at the hospice.

“After accepting the hospitality of the monks and spending a short time in the library and chapel, he resumed his journey; and on the southern slopes he and his staff now and again amused themselves by sliding down the tracks which the passage of thousands of

THE FORT AT BARD

men had rendered slippery. After halting at Aosta he proceeded down the valley to the fort of Bard.

“Meanwhile, some of his foot soldiers had worked their way round this obstacle by a goat-track among the hills, and had already reached Ivrea, lower down the valley. Still the fort held out against the cannonade of the French ; its commanding position seemed to preclude all hope of getting the artillery past it, and without artillery the First Consul could not hope for success on the plains of Piedmont. Unable to capture the fort, he bethought him of hurrying by night the now remounted guns under the cover of the houses of the village. For this purpose he caused the main street to be strewn with straw and dung, while the wheels of the cannon were covered over so as to make little noise. They were then dragged quietly through the village, almost within pistol-shot of the garrison ; nevertheless, the defenders took alarm, and, firing with musketry and grenades, exploded some ammunition-waggons and inflicted other losses. Yet forty guns and a hundred waggons were got past the fort.

“How this unfailing resource contrasts with the heedless behaviour of the enemy ! Had they speedily reinforced their detachment at Bard, there can be little doubt that Bonaparte’s movements could have been seriously hampered. But up to May 21 Melas was ignorant that his distant rear was being assailed, and the 3,000 Austrians who guarded the Vale of

BONAPARTE'S VICTORY

the Dora Baltea were divided, part being at Bard, and others at Ivrea. The latter place was taken by a rush of Lanne's troops on May 22, and Bard was blockaded by part of the French rear-guard.

"Bonaparte's army, if the rear-guard be included, numbered 41,000 men. Meanwhile, farther east, a French force of 15,000 men, drawn partly from Moreau's army and led by Moncey, was crossing the St. Gothard Pass, and began to drive back the Austrian outposts in the upper valley of the Ticino ; and 5,000 men marching over the Mont Cenis Pass threatened Turin from the west.

"The First Consul's aim now was to unite the two chief forces, seize the enemy's magazine, and compel him to a complete surrender. This daring resolve took shape at Aosta on the 24th, when he heard that Melas was, on the 19th, still at Nice, unconscious of his doom. The chance of ending the war at one blow was not to be missed, even if Masséna had to shift for himself."

Thus interestingly does Mr. J. Holland Rose describe Napoleon's crossing of the Alps by way of the Great St. Bernard, and to him also we are indebted for the quaint frontispiece to this chapter,* a reproduction of the picture by David.

In crossing the Alps upon a present-day pass, and picturing to one's self the clefts and ravines without their roadway, and again when their sides were

* From his "Life of Napoleon I.," through the courtesy of Messrs. Bell.

ALPINE ENGINEERING

alive with sappers and soldiers tearing out the rocks and fashioning a crude *pavé* such as that of Napoleon we have examined below—our admiration is aroused—albeit mingled, it may be, with regret that the fastnesses of Nature should be thus encroached upon—by the admirable manner in which modern engineers have not only negotiated the difficulties,



XCI.

but have provided us with roads, reducing the fatigue of the tourist, and, more important still, that of the “diligence” horses, to a minimum. In effecting this the aim of the engineer has been to construct a rising highway of uniform inclination, or, as he would call it, “constant ramp”; and the smallness of this incline, which in the case of the Simplon

MOUNTAIN ZIG-ZAGS

is but about one inch per foot, is surprising when the steepness of the mountain-side is considered.

To carry this out it is, of course, necessary to construct the passes in the form of zig-zags. The acute reticulations of one of such, and the sinuous folds and convolutions of another, are interestingly depicted in two of our photographs. The success he has achieved in this is deserving of both our admiration and our gratitude ; but our feelings are tinged with a shade of apprehension lest these Herculean works, their cost having been enormous, may in the near future largely fall in desuetude, for one by one the passes have had companions added to them of miles-long burrows, piercing the solid



XCII.

rock and connecting two countries with a link of gloom.

To the ordinary reader words could scarcely convey any adequate idea of the magnitude of the work entailed in the construction of an Alpine tunnel, of the Antæan labour involved, and the colossal capital expended. The last of the great passes to have its tunnel added is the Simplon, which has the advantage of utilizing the great experience gained in the engineering of its *confrères* ; and there-

ALPINE TUNNELLING

fore the time taken, the cost, and the very heavy mortality, it is expected, will each be very greatly reduced. Hitherto the death-roll has been, unhappily, very heavy, and strenuous endeavours are being made to reduce it in this instance, the two principal factors being the noisome and vitiated nature of the atmosphere, and the contrast between the heat, labour, and fatigue within the bowels of the mountain and the coldness of the Alpine air



XCIII.

without. To avoid the heavy death-rate which obtained on the St. Gothard, for every cubic foot of air pumped into the former tunnel, fifty times that amount is being delivered into the Simplon, whilst special arrangements for cooling the air by fine jets of water and spray have been made. Moreover, the men on emerging from their work, wet through and fatigued, are not allowed to go from the warm headings into the cold Alpine air outside, but pass into a large building suitably warmed, where they

ALPINE TUNNELLING

change their mining clothes and are provided with hot and cold douche baths. There also they put on warm, dry clothes, and are able to obtain excellent food at moderate cost before returning to their temporary mountain homes. Their wet and dirty mining clothes are taken charge of by appointed custodians, who dry and clean them ready for the morrow's work. These and other precautions are expected to reduce the death-rate to a very great extent. .



XCIV.

In one of our illustrations we show the commencement of a pair of great Alpine tunnels puncturing the hard rock-face ; in another the powerful hydraulic rock-drill entering the tunnel with its gang of workmen ; in a third the method of bringing out the *débris* by transporting the small hand-moved tunnel-waggons upon larger trucks drawn out by a steam locomotive.*

* For these photographs we are indebted to Mr. Francis Fox, M.I.C.E.

ALPINE TUNNELLING

Despite the energy at the engineer's disposal, and his army of workers, in the earlier essays to burrow beneath the mountains he at first only succeeded in winning his way at the rate of less than a yard per day. Latterly, however, this speed has been increased to 5 or 6 yards per diem, and is still being improved upon.

These remarks will convey some impression of these great subterranean works ; whilst with regard



xcv.

to the laboriously cut zig-zags up which we press, and which are so interestingly shown in our two photographs xci. and c., it may be of interest to add something as to their construction.

Take the case of the Simplon, to which we have referred. This was constructed under the orders of Napoleon, who seems to have determined that in throwing his army again across the mountain chain and into Italy—it might be to fight a second Marengo—his men should not have to overcome

ALPINE ROAD CONSTRUCTION

the difficulties and encounter the hardships of the Great St. Bernard. In order to expedite the construction of the pass, it was commenced simultaneously at both the Swiss and Italian ends in 1800, and absorbed the labour of a civilian army of upwards of 30,000 men, directed by a most able engineer and his staff, for no less than six years.



XCVI.

The work consists not only in road-winning, entailing the blasting away of hundreds of tons of rock, but it is necessary at many points to construct tunnels, some of these being of considerable length, the entrance to one of such being shown in one of our photographs, whilst at points specially subject to avalanche and stone-slip galleries have to be constructed.

These avalanche galleries, too, are often of consider-

AVALANCHE GALLERIES

able length. They are constructed either of solid masonry or of strong timbers, their roofs in either case being built with a gentle slope towards the ravine, so that the avalanches may slide over them and fall therein. One of these, of timber construction, and curving round the side of a mountain with the ravine at its side, we see in the photograph upon the preceding page.

Some of the galleries upon the Italian side are lighted by evil-smelling oil-lamps, whilst their road-



xcvii.

ways are here and there knee-deep in mud, so that one is fain to carry one's cycle upon one's shoulders; and the contrast between the gloom and the noisomeness within and the light and

brightness without is so accentuated that one can with difficulty bear the bright sunshine for a few seconds on emerging upon the external roadway, the surface of which is always kept in admirable order. Despite these precautions, a heavy fall of snow, even in summer, may quickly block a pass, and to guard against this a large staff of road-men are always available to cut a road through the deeply-drifted snow.

One of our photographs is very interesting as

AVALANCHE GALLERIES

showing the excavation of a portion of the pass in the solid snow, which takes place usually in May or June, when efforts are being made to get the passes open, an idea of the height of the snow being obtained by comparison with the height of the tall Alpiners standing beside it and of another standing upon a waggon piled high with excavated snow. In another photograph are shown the road-men engaged in breaking away the giant icicles which have insinuated themselves between the joints of the timbers forming the roof of a timbered avalanche gallery, of that type the exterior of which is shown in a previous photograph, XCII., their four-footed companion seated upon the frigid floor contentedly watching the operations. The roofs of these timber avalanche galleries, as will be seen from the external (XCVI.) view, have a gentle slope, over which the huge icicles—veritable ice streams—creep, their chill, green-white bodies often hanging for hundreds of feet down into the ravine beyond.



XCVIII.

Alpine passes are liable to be blocked by snow-falls at any time, but they finally become impassable usually about the commencement or middle of October, and remain closed until May, during which month travellers across the Alps find themselves spending much time between deep walls of snow

THE PASS

or in shallower "cuttings" of the snowfields. Our photograph is a "snap-shot" of such a cutting taken from the top of a "diligence" and showing the heads of the "leaders."

Leaving Bourg St. Pierre, we commence our ascent on a good road and with but a gentle *rampe*. The commencement of the pass is broad, the mountains on either side imposing, whilst just above us



XCIX.

is the snow. Winding hither and thither, first on one side and then on the other of our route, we see the narrow, roughly-paved road constructed by Napoleon. Even here the wind is strong and bleak; it blows in our face so fiercely that it would seem to warn us not to mount to the solitude where it whirls its fitful courses almost unmolested

CHARNEL-HOUSES

by a human being, except the poor travellers who are journeying with empty pockets between the lands of the olive and the mountain ash.

As we ascend, we pass here and there little rough stone buildings ; these are filled with the skulls and bones of those who have succumbed to the severity of the cutting blast and the steely grasp of Frost's icy fingers. We plod on, our mount our only companion, trundling silently beside us, breaking not the solitude, save by the gentle cracking of the crisp snow beneath its soft tyres.

Another two or three hours, and now all above and around is snow. We look forward, wishing to see the hospitable hospice, but we see nothing skywards save heavy banks of cloud, dark and lowering, which, speeding o'erhead, are impelled by the invisible yet puissant force of that same chill *Æolus*, whose harsh buffetings force us from time to time to turn our back to him to dry our streaming eyes and to regain breath. We think of Longfellow's words :

“ ‘ Try not the pass,’ the old man said ;
‘ Dark lowers the tempest overhead.’ ”

We think also of the striking contrast of winter with summer—a contrast more pronounced in these high altitudes than in the lowlands, for then,

“ Lulled by the sound of pastoral bells,
Rude Nature's pilgrims we would go
To the dread summit of the Queen

A PATH OF PLEASURE

Of mountains, through a deep ravine,
Where, in her holy chapel, dwells
'Our Lady of the Snow.'"*

For, summer or winter, the snows are near companions of the lonely hospice.

In the summer, however, so many travellers climb



c.

the pass by its good but tortuous and zigzag road
that it has almost become

"A path of pleasure. Like a silver zone
Flung about carelessly, it shines afar,
Catching the eye in many a broken link,
In many a turn and traverse as it glides,
And oft above and oft below appears."†

But it is winter and we have now been ascending
some time, and every herb, every bush, every tree,

* Wordsworth.

† Samuel Rogers.

A TORTUOUS ROAD

e'en every rock and every crag, has disappeared ;
all are hidden 'neath a yards-thick mantle of virgin
snow.

All the morning we had heard roarings and
rumblings, and had not yet appreciated their cause ;
but Longfellow asks and tells :

“ What sound is that ?

The tumbling avalanche !

How awful, yet how beautiful !

These are

The voices of the mountains. Thus they ope

Their snowy lips, and speak unto each other

In the primeval language lost to man.”

We push on, for, if there be danger, it is not in
the going, but in the stopping, except in the case of
those subject to *mal-de-montagne*—an unpleasant
giddiness and faintness caused by leaving the denser
air of the valley and inspiring the rarefied atmo-
sphere of the greater altitude. For this a halt
should be made ; but if the sufferer be not alone, his
friends should take every means to keep up his cir-
culation and warmth whilst the effect is passing off.

A pedestrian upon this very pass—albeit it is a
comparatively low one—thus describes his experi-
ence in this respect :

“ Within an hour of the hospice I was seized with
mal-de-montagne.* It was the first time I had heard

* Physiological phenomena at high altitudes are extremely
interesting, and have already received some attention at the

“MAL-DE-MONTAGNE”

of or experienced this strange sickness, and anything more unpleasant I can't conceive. My throat was dry ; my head ached, as did my limbs ; and in the

hands of scientists. This mountain-sickness has been investigated by Professor Mosso, of Turin, who finds that it commences with most climbers at a height of 12,000 or 13,000 feet. It is an extreme lassitude, with panting for breath, and sometimes vertigo with nausea, and a tendency to syncope. According to the tests for oxygen in the blood made by Egli-Sinclair, it is due to lack of oxygen ; but Professor Mosso finds that it also arises from lack of carbonic acid in the blood. It is, therefore, the contrary of asphyxia, which is owing to excess of this gas in the blood, and he proposes to call it “acapnia” from the Greek “without fumes.” The loss of carbonic acid is due, it appears, to diminution of pressure in the air.

On the other hand, M. de Thierry, in a note to the Académie des Sciences, Paris, states that carbonic acid gas is not confined to the lower strata of the atmosphere, but exists in nearly the same proportion at a height of 12,000 feet on the Grands Mulets as it does 6,000 feet lower down. Professor Mosso, it appears, relieved a sufferer by giving him carbonic acid gas to breathe, whilst he states that certain tourists confined by the weather to a small hut on Monte Rosa would have suffered from the sickness but for the carbonic acid gas in the hut given off by the stove. Other experimenters have included muscular exertion as one of the causes or predisposing causes of *mal-de-montagne*. If Mosso's results are confirmed, it will be advisable for balloonists and mountaineers to carry not only oxygen but carbonic acid, if they would ascend higher than 12,000 feet.

The aeronaut, however, is not placed so disadvantageously as the mountaineer, for he has not to withstand the effects of excessive exertion. Engineers have found that in building a railway labourers can work only one-third as long at an altitude

"MAL-DE-MONTAGNE"

most unexpected manner I dropped on the snow, with an overpowering desire to sleep there and then. My friend dragged me out of the drift, and laid me out on a flat stone projecting above the snow. We sent on the guide to advise the monks of our coming, and after a time I managed to stagger along with a little assistance. But the sickness would not let me go far; every now and then it would grip me by the throat and heart, and reduce me to a state of absolute helplessness. Luckily, I escaped bleeding at ears and mouth, which, I understand, is the last and most dangerous stage of this malady; but the slight attack I had was sufficient to prove to the full its disagreeable qualities.

of 10,000 feet as they can in the valleys. Moreover, modern science has proved that fatigue causes chemical changes in the blood, resulting in the production of a poison resembling the curara poison, which certain savage tribes use for arrows. Arrow poison, however, is of vegetable origin. And also that when the blood of a tired animal is injected into the arteries of a fresh one, the latter exhibits all the symptoms of fatigue. Locally, *mal-de-montagne* is attributed to fatigue conjointly with lack of oxygen, and we remember the good father of the Hospice at Simplon once enjoining upon us if we felt faint to *eat* the snow! "Because," said he, "you may become faint for lack of oxygen, and mountain-snow contains much air." This fact is very obvious to the observer, and it is possible that the oxygen occluded within the interstices of mountain-snow may be in that form—so potent for oxygenation, and hence restorative and warmth imparting—known as ozone.

A BARK OF WELCOME

"We neared the monastery; down came one of the celebrated dogs—a large tawny animal—who, deciding that we were genuine outcasts, summoned assistance with loud and persistent howlings. Aided by two men, not monks, we managed to scale the last and steepest ascent before reaching the hospice, and within a short space of time, considering the difficulties of the ascent, we were within its hospitable



cl.

walls. The monks took us to the kitchen and thawed us, and fed us with a kind of wine soup, after which we retired to bed. The thirty-mile walk, the snows, and the sickness were too much for me, and I slept sounder than I had ever done before. Had the world ended then and there, I do not

think I would have cared much."

As for ourselves, we had no such unpleasant experience; our ascent was one of pleasure, not of pain. We must confess, however, that the time seemed longer than that which we had been told we should take. We plodded on in lonely doggedness; but it was hard going in the deep snow, and yet

MESSENGERS IN SHAGGY COATS

there was no hospice in sight. This, however, is easily explicable : firstly, it is hidden from sight by a slight bend in the pass, and only comes into view when we have somewhat rounded a headland ; and, secondly, it was quite impossible, in our case, to see ahead at all, for the powder-like snow which *Æolus* dredged into our eyes, and the larger flakes he sent dancing and flying in fantastic gyrations before and around us, precluded this.

“For in the narrow rent, at every turn,
Winds thwarted winds, bewildered and forlorn.”

We love the cold ; we love the mountains, and the solitude and romance hovering among their brusque and giant forms ; and, despite our profession, we hate to see the applications of science marching onwards, Alpwards. Yet it brought an inward satisfaction, one but niggardly confessed to one's self, to know, as we toiled upwards slowly and laboriously, a message had sped on the lightning wings of Electron through that thin wire there depending from those rough fir posts cropping up here and there above the snow, telling of our coming—a satisfaction to know that, were we long after the allotted time of coming, messengers in flesh and blood and shaggy coats, with speechless voices loud and deep, and scent and instinct which passeth all understanding, would be speeding towards us on legs powerful as they are fleet, calling to us before

A TRUMPET BLAST OF WELCOME

they had seen us, and telling us of their approach in deep, sonorous bays which would go welling forth down that mountain pass, loudly but dully reverberating from side to side of that chilly, snow-muffled gorge—a trumpet blast of welcome, sympathetic and sincere—dear, noble dogs, bearing the name of a man pure and good, who has aptly been termed “a winter saint,” for are not the walls of the hospice he founded a thousand years ago hemmed in by eternal snows?

Presently we see before us the white walls of this same hospice of St. Bernard, looking almost as cold as the snow around them.

“A pile of simplest masonry,
With narrow windows and vast buttresses,
Built to endure the shocks of time and chance;
Yet showing many a rent, as well it might,
Warred on for ever by the elements,
And in an evil day, not long ago,
By violent men, when on the mountain-top
The French and Austrian met in conflict.”*

As we come in sight of the venerable pile, two St. Bernards who are on duty see us, and bark so loudly that we might take it for a menace, did we

* S. Rogers. There are now two large buildings, the smaller, the *Maison de St. Louis*, reserved exclusively for the poor, and kept, as it were, in readiness in case of a second fire, being so placed at an angle and in relation to the first as to act as a groin rampart to divide the avalanches, and thus protect the larger building.

SCARCE TUTORED INSTINCT

not know they are not speaking to us at all, but to those within the hospice. Then

“Two dogs of grave demeanour welcomed me,
All meekness, gentleness, though large of limb,
. . . lay-brothers of the Hospital.”

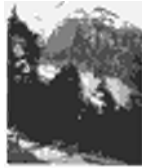
One of the Brothers subsequently informed us that three or four hardy fellows—laymen, called *marronniers*—are kept at the hospice, whose duty it is—two at a time—to follow the dogs, who go much quicker than they, with creature comforts for the snow-embedded traveller. One of the two hounds—two are sent out at a time—carries first aid in the shape of a little wooden keg of *kirsch*, or white brandy, whilst his companion generally carries a paletot, with which the snowed-up and benumbed traveller may cover himself until the men arrive, the second hound going back to lead the *marronniers* to the perhaps insensible traveller, by whose side will be found the first stalwart, faithful hound, comforting him with his warm breath and licking with pure and disinterested affection the cold face and numbed hands of the unfortunate traveller. Of such is the scarce-tutored instinct and demeanour of these noble friends of man.

Here we found it more expeditious to shoulder our mount in completing the ascent, and half an hour later, with it thus poised, we strode up the ice-covered stone steps of the monastery—steep steps

"AT THAT LOW DOOR"

put there to prevent its hospitable door becoming
clogged and unapproachable by snow. And it was
with satisfaction that we stopped

“at that low door—
That door which ever, as self-opened, moves
To them that knock, and nightly sends abroad
Ministering spirits.”



32



To face Chap. VI.

THE HOSPICE.

CHAPTER VI

THE HOSPICE

“ Long could we have stood,
With a religious awe contemplating
That House, the highest in the ancient world,
And destined to perform from age to age
The noblest service, welcoming as guests
All of all nations and of every faith :
A temple sacred to Humanity.”



CH.

WE ring the great bell, and its vibrations go resounding up the staircase and along the stone corridors of the monastery, to be quickly responded to by a Father, who shakes hands with us as if he were a Christmas host and we an expected guest. “ Firstly, then,” said he, “ you would wish to refresh yourself. I will send a Brother to you, who will serve you.” The Father was a small man, lean and spare, with a wrinkled countenance and *pratal* cap upon his head. Soon came the Brother, quite

THE BROTHER

a contrast. He was a big, broad fellow, with a large head as round as a Dutch cheese and as closely cropped as a convict, so that his tonsure showed distinctly, for he held his little, close-fitting black skull-cap squeezed up in his hand as he addressed us, but rearranged it on his head as he led us to the *Salon des Étrangers*.

As we pass up the staircase we notice a small stained-glass window, representing the *débris* of an avalanche, whereon is a Father holding a lantern above the body of a traveller embedded in the snow. Whilst one St. Bernard, who has found the stricken traveller, licks his hands, the other is in the act of baying for assistance; other Fathers and Brothers are seen in the distance hurrying to the spot. In the background of the picture is seen the mountain summit with the monastery, from which the welcome guiding light is streaming.

Steaming soup and red wine were quickly set before us, with a huge monasterially-baked loaf; then followed meat and cheese. We soon learnt from our Brother that we were the only guest of the day, for, as he explained, it was very late in the year for travellers, and we therefore claimed his kindness to show and explain to us this hospice, of which we had heard so much. In half an hour he would be with us again to take us to the library and the chapel.

We chose to spend this half-hour with the dogs.

CUISINE AND COWS

We saw one noble fellow below, and called to him to come up the staircase; but he only raised his great head and came a few steps and then stopped short. "He knows he mustn't come," said my friend the Brother; "he is not allowed. Go down, and you will find others." We went down to their quarters, the lower corridor of the heavy building. It is sepulchral of aspect, cold, damp, and clammy. Its paving-stones are black and cracked and greased with the drippings of many a serving Brother as he journeys from the cellar-like *cuisine* to the *salon*. Its heavy arched passages are cold and chill, and the whole is far from savoury, too, for this *étage* is the domicile of the monastic cows as well as of the hospice dogs. The place cannot have been white-washed since its foundation, and the contrast between the pure mountain air and the *animal*-odorous atmosphere of the interior is better in imagination than in realization.

In a great chill masonry-vaulted common-room were—huddled together for warmth—a small group of vagrants, German and Italian. The men were thin, emaciated, and repulsively dirty; the women were hags, repulsively ugly. There they crouched by their staves and bundles, sole representatives of their worldly belongings, in an atmosphere so noisome and fœtid we were glad to exeunt.

We made for the door at the rear. There we found a great trough filled with boiled rice, and a

ROMPS

fine old dog leisurely partaking of it. He looked too venerable, too pompous, and too important—and, be it said, too ponderous—for us to invite him to romp with us. But we soon found two youngsters, and they were nothing loth. We had a romp, and we found they had more breath than we had; so we sat upon the steps outside, one dog on either side of us, their pink tongues, smiling faces, and white-teethed muzzles reaching above our head. Suddenly and without any warning, the mother—a grand old lady, not past her gallivantings, though—came bounding along the corridor, and uncereemoniously swept all three of us half a dozen steps down into the snow. Before we had recovered our surprise—to say nothing of our breath—there they were far out in the snow, plunging and tumbling each other over and over—as, indeed, they had us—the while throwing up clouds of the pure, crisp snow. “There they go!” says my big Brother, who had arrived just in time to witness this gymnastic and unrehearsed performance, laughing and shaking his ample girdle. “As soon as we let them out, they make for the snow and enjoy themselves like that. They love it.” And there they *did go*, plunging and rolling like tawny porpoises in an Arctic sea. Their huge paws, broad and padlike, seem to be a kind of natural *ski*, or snow-shoe, and enable them to bound and slide with surprising speed over the frozen and snowy surfaces. They are as majestic

THE GRIMSEL HOSPICE

and handsome as they are humane and useful. We were informed that one dog had saved over fifty



CIII.

lives in fifteen years; but this canine hero is no more in the flesh—he is stuffed and in a museum.*

* The keen sense of smell enabling these dogs to track and disinter travellers from the snow has for long created surprise, and aroused admiration for them; but the original stock, said to have emanated from the Spanish Pyrenees, is said to have become extinct.

Dr. Gordon Stables, the canine authority, speaking of the general appearance of the St. Bernard, says: "He is an extremely large and powerful fellow, with a beautiful head and speaking countenance, in which sagacity is blended with nobility, and a body of great symmetry, combining, one might say, the agility of the Newfoundland with the strength of the British mastiff. The head is a truly great one, and a grand one. It is not altogether unlike that of the Newfoundland, but is higher in the skull, and the occipital protuberance is more fully developed. The

THE GRIMSEL HOSPICE

The romps we had with these noble creatures reminded us of others we had had with their brothers and sisters elsewhere, and also of an unpleasant reception one had given us at the Hospice on the Grimsel.

The Grimsel Hospice is situated over 6,000 feet above sea-level, and to get to our destined sleeping-place at the foot of the Rhone Glacier (Gletsch) we had still to climb another 1,000 feet. The sun had set; we had watched enchanted the glorious after-glow, and our object was to refresh ourselves as quickly as possible with a small bottle of red wine and some bread and cheese—about the only things available in mid-winter. The venerable domestic, despite the fact that this was explained to him, was most tantalizingly slow, and insisted on our entering a kind of outer kitchen, almost dark, whilst he sought the much-desired bottle. Our presence there appeared to be very distasteful to a couple of dogs, whose dimensions and breed one could tell, without seeing them, by their mouthings. After much delay

crown is large, round, and raised, the muzzle is plentifully developed, very broad, and squarely cut off at the end. The eyes are of fair size, and extremely mild and benevolent in expression." In our illustration, from the work of "Stonehenge," are seen one of each variety—smooth and rough coated. In Dr. Stables' opinion, however, there is but one variety, since, as he points out, both long and short haired are often found in the same litter.

AN IMPRESSION OF MOLARS

he reappeared, bottle in hand, and very indiscreetly opened the inner door, with the result that one of the powerful St. Bernards, doubtless thinking it his duty, sprang at our face. Protecting this with an arm, we received an unwontedly faithful impression of his molars just above the wrist—despite the fact that they had to penetrate a thick pilot coat and two layers of “sweater”—which for days made it difficult to grasp the “handle-bar.”

In descending to Gletsch, knowing that nobody was expected nor had been since the last “diligence” passed—a couple of months previously—and that nothing in the shape of a bed would be ready, we tried the strength of our lungs with a vigorous “*Hé là!*” thinking that it might be answered by the deep bay of a St. Bernard, in which case the caretaker would soon be out to inquire why the dog had spoken. Had our voice reached to the interior of the common room, half a dozen noble St. Bernards would quickly have been at the door, and that at least a good hour before us. There were voices, however, within, which more than overpowered the voice of another without, and a couple of thousand feet above the roof. So we continued to run down until close enough to make ourselves heard, when a flood of light came out of the opening door, and with it half a dozen St. Bernards, but, what at the time surprised us most, half a dozen men also. Jumping off our machine, we seemed to be in a little sea

CANINE SUPPER COMPANIONS

of dogs as high as the machine itself. Entering the rough room, we said we were glad the reception by them was not a repetition of that at Grimsel, at the same time rolling up our "sweater"—now saturated with blood—to show the unwonted imprints. "*Sapriste! sapriste!*" quoth the honest miners, and, taking this as a hint that we disliked dogs, the group was bundled into an adjoining room, and there they stood, half a dozen of the noblest canine heads one could imagine, looking on through the open doorway. We begged that a couple might come and keep us company at supper, and two came, and there they sat, one on either side, and two pairs of beautiful eyes watched our every move, two magnificent heads rose nearly as high as our shoulders.*

On setting out again the following morning, we were both interested and gratified by the demeanour of our canine supper companions, for they behaved much as well-bred human beings might have done. They were beside us, watching our tying a loaf of bread, hollowed out and stuffed with half a dozen hard-boiled eggs, to our handle-bar, the while declin-

* The St. Bernard is a perfect giant amongst dogs—tall and heavy as the mastiff, standing from 29 to 33 inches at the shoulder, and weighing from 130 to 170 pounds. "Sir Bedivere," when not fully grown, was 34½ inches, and weighed over 200 pounds. "Lord Bute" stood 36 inches high, and weighed upwards of 220 pounds.

PATS OF GRATITUDE

ing the kindly offers of the honest miners to conduct "la machine" to the top of the pass, and receiving many *adieux* and "safe overs," and there we expected to bid our four-footed hosts also *adieu*. They knew well that the first arm of the rising zigzag takes one a short mile onward, and that the next brings one back to just where one started, but higher up the mountain-side. So having seen us commence our laborious pedal upwards, they again stretched themselves out in the snow, doubtless having made up their minds that it was there, high up above the chimneys of their own roof, that they intended with their grand expressive eyes to bid us in mute language their *adieux*; therefore, a few minutes before our return along the mountain-side they sprang up, and, with a grand spraying of the crisp snow as they fleetly clambered up the steep side, they were with us in an incredibly short time, with pink tongues protruding, sides bellowsing, and sterns wagging.

Receiving our pats of gratitude for their kind companionship, they on our remounting began their descent, and it was truly surprising to watch their great bodies disappearing down so steep a place without their being actually rolled over. With muzzles to the ground they kept together, once or twice making a *détour* to an extra deep pocket of snow to roll in it, and to gambol like a couple of clumsy youths at play, and as we have just seen

THE BIBLIOTHÈQUE

their brothers and sisters romp on the summit of this Great Saint Bernard.

“Let us go to the Bibliothèque,” says the Brother. Thither we mounted, and spent a pleasant couple of hours there, which, however, would have been more pleasant had it not been for the intensity of the cold. Our stout Brother seemed to be fond of reading, and to have the habit of reading aloud, and it certainly added to the weirdness of the solitude to hear the continuous mumbling of this *religieux* as we turned over a few of the *tomes*. Next in numbers to theology certainly came natural science, and we could not refrain from thinking—and this not without *colère*—how vastly progress had been impeded in bygone ages by the confiscation of such works, whereby they were withheld from those who could have done well with them, and the locking of them up in monasteries such as this for the sole delectation of monks and friars, amongst whom there were all too few of the philosophical *genre* of Friar Bacon, Abbé Caselli, Torricelli, and the like.* One recalls that the confiscation

* The prescience of the learned Franciscan monk Roger Bacon was indeed astonishing, for in the thirteenth century he made the extraordinary prophecy that—“We will be able to construct machines which will propel large ships with greater speed than a whole garrison of rowers, and which will need only one pilot to direct them. *We will be able to propel carriages with incredible speed without the assistance of any animal.*” Surely a prognostication of enchanting relevance at this moment, when carriages without

THE BIBLIOTHÈQUE

of a single work retarded progress in regard to the steam-engine nearly a thousand years.

Pulling down a very old work on astronomy, we read a title-passage which recurred to us at night

horses are appearing in our streets. But he went farther, and said: "And we will be able to make machines which, by means of wings, will enable us to fly into the air like birds" Also attesting prescience of no common order, and a prophecy of particular interest to us at this moment, when the self-propelling and dirigible balloon has just proved to be *un fait accompli*. Truly progress proceedeth sluggishly, for Bacon tells us that certainly a *flying machine* existed *then*, and that he knew the name of the inventor thereof. Bishop Wilkins, who lived from 1614 to 1672, was even more sanguine, for in his "Discovery of a New World; or, That the World may be a Moon," he sets out the proposition that 'tis possible for some of our posterity to find out a conveyance to this other world, remarking that it seemed no more incredible than did the invention of ships:

"So bolde was he who in a shippe so fraile
First ventur'd on the treach'rous waves to saile."

But Bacon was a friar as practical as he was speculative; his "Opus Majus," which actually advocated the use of philosophy in theology, contained a treatise on optics and experimental philosophy, whilst his discovery of optical lenses has been established beyond a doubt, and it is also certain that he conceived and described the telescope. The Abbé Caselli, another learned divine, in the solitude of his monastery invented and constructed his pantelegraph, with which he actually sent both writing and sketches by electricity; whilst Torricelli, another monk, amongst other scientific work, invented the barometer, and, being unsatisfied with the formula, "Nature abhors a vacuum," discovered the law which subsequently enabled men to make pumps.

THE BOUNDARY STONE

when we stood in awe and admiration contemplating the Alpine star-covered heavens:

"Deux objets remplissent l'âme d'un respect et d'une admiration qui ne cessent de s'accroître, à mesure que l'esprit s'en occupe, et plus souvent et avec plus de suite—c'est le ciel étoilé sur ma tête et le sentiment du devoir dans mon cœur."

In the library is a collection of medals and a number of Roman relics found in the vicinity of the monastery. Also relics of a pagan temple which ages ago stood here—that of *Jupiter Pœninus*—so that the spot had been a sacred one e'en before the advent of St. Bernard.

Having paid a visit to the "highest library in the world," we had just time for a stroll in the vicinage of the hospice before darkness. We go along the pathway specially cut to afford exercise to the *religieux*, who, among the many hardships inherent to life at so elevated an altitude, find the difficulty of getting proper exercise on the snow-laden ridge not the least.

It is quite close to the hospice that one comes upon a large stone, marking the boundary of Switzerland and Italy, and it is the practice for visitors from the northern side of the Alps to walk thus far and to circumambulate the pillar, so as to be able to say, "We have been in Italy."

Close here, too, stood the temple to Jupiter Pœninus, to which we have referred, where early

ANCIENT HOSPICES

travellers stopped to worship at the shrine of that god, leaving him presents in the form of votive tablets. It was from this shrine that the mountain derived the name of Mont Jovis, the pass Jugum Pennium, this spot being called to this day *Mont Joux*, or the platform of Jupiter. It is a small, irregular, and uneven plateau, surrounded by mountain summits, those of Mounts *Chenaletta*, 2,890 mètres; *Mort*, 2,860 mètres; *Point de Dronaz*, 2,950 mètres; the *Pain de Sucre*, a pointed mountain, 2,900 mètres; opposite the end of the cleft on the Italian side, the *Col de Fenêtre*, 2,700 mètres; and the *Tour des Fours*, 2,930 mètres. Close by us, on the edge of the plateau, is a monument to Mr. Martinet, who lost his life in descending the Italian side in 1868.

The necessity for some sort of shelter for the traveller must have made itself felt here at a very early date, and it is known that some sort of a monastery and hospice existed on the pass as early as the ninth century. One of some size was erected here in 859, but this was burnt about 100 years later. The present hospice is the one founded by Bernard de Menthon, who subsequently became Archidiacono of Aosta. This was built in the year 962, but it was enlarged as recently as 1822.

Bernard was born of noble parents in 923, in the reign of King Raoul, in the castle which still exists on the hill above the lake of Annecy. His father

BERNARD OF MENTHON

was the Baron Richard of Menthon, said to have been possessed of most estimable qualities. His mother, too—Bernoline, of the ancient Duin family—was also of noble parentage, being the daughter of Viscount Tarentaise, Lord of the Val d'Isère, and descended from Count Olivier of Geneva. Bernard derived his name from his godfather, the Chevalier Bernard, Lord of Beaufort.

From his very birth onwards, we are told, this Bernard, afterwards to become a saint, was possessed of attributes of character which caused him to be loved by all.

“ On peut dire en effet que, dès le jour de sa naissance, Bernard donna des signes non équivoques de la haute sainteté à laquelle il était appelé. Il ne fournit jamais à sa mère ni à sa nourrice la moindre occasion d'ennui ou d'impatience. Le doux sourire qu'il portait sur ses lèvres, présageaient son caractère futur. A mesure que les traits de son visage se caractérisaient, ils révélaient en lui une beauté et des attraits qui ne permettaient pas qu'on le vit sans l'aimer.”

At six years old he could write his letters and “was commencing to join the syllables and make words.” As his voice strengthened, he commenced the singing of hymns and *cantiques*, courageously overcoming the difficulties which the music of the time presented.

As he grew up the Baron desired that his son should receive such education and experience as

should properly fit him to take his place among his acquaintances of noble birth, and for that purpose he desired him to go to Paris. It is true that in the tenth century no University existed, and that these excellent institutions only made their appearance in the thirteenth; but there existed in Paris the fine school which had been founded by Charlemagne in 792, and to this his father desired him to go.

The thought, however, was far less congenial to young Bernard than the reposeful quiet of the Manor of Menthon. "*Mais il ne sait rien refuser à des parents chéris, dont il respecte les volontés, et Bernard reçoit leurs ordres comme venant du ciel,*" and accordingly went. We are told that an ineffaceable void was thus created in the château, keenly felt by the gentle Bernoline. "*Le cœur de cette mère tendre est plongé dans un abîme de douleurs,*" say the manuscripts, but they tell little of the life of the young man in the capital; they only speak of the almost phenomenal progress made by him in his studies, his extraordinary aptitude for the sciences, and the manner in which he outstripped his fellow-students. Making himself master of all the known sciences of the time, he attacked what is spoken of as the "highest of the sciences"—theology—and this with the greatest success. By this time young Bernard appears quite to have made up his mind as to the course his life should take.

BERNARD OF MENTHON

Innocence is exposed to much of peril in public schools, and above all in a large capital ; nevertheless, like Tobit, who remained faithful amid the corruption of Nineveh, "*Bernard garda son cœur avec tant de vigilance, que jamais le poison impur ne pénétra dans ce sanctuaire.*" The *divertissements* of the world had no attraction for him, though he saw his companions partake liberally of them. "Bernard chose the road of the Church to lead him to heaven ; he remained in his room and read the Scriptures." He knew well that chastity is a flower—a flower whose beauty the slightest breath may sully, a single lewd regard may destroy, and he had learnt that it could only be made to live and grow in the soil of mortification, invigorated by the waters of self-denial.

Thus were his younger days spent ; then we are told he was *thrice tempted*. His troubles arose, firstly, out of wealth and ambition ; then from filial affection ; and, thirdly, from that other affection which we poor unenlightened laymen consider the highest and purest, but which the *religieux* appear to view as lustful—the desire for marriage.

The first is said to have been the one which required the strongest combating, for he would be rich, and out of this circumstance grew worldly ambition ; as to the two others, his sense of duty—mistaken, in our opinion—overcame them. It was necessary for him to give up his home and separate from his parents. This he did. It was necessary

THE LAKE

for him to live the life of a celibate. This he submitted to. And it was necessary for him to abjure the use of his wealth in worldly things. This he devoted to the Church. We cannot here recount his many good works; but we see before us his crowning one, in erecting which, for the alleviation of the sufferings of his fellow-creatures and the prolongation of their lives, he at the same time inadvertently erected a monument to himself, long to perpetuate the memory of a good man and saint.

Dreary indeed it is up here upon the mountain ridge, but how much more dreary would it not be were there no hospice, if one had nowhere to seek, no shelter to fly to, no succour to rely upon, no hands to revive, no voice to cheer, no hope of comfort?

“On the same rock beside it stands the church,
Reft of its cross, not of its sanctity. . . .
And just beneath it, in that dreary dale,
If dale it might be called, so near to heaven,
A little lake, where never fish leaped up,
Lies like a spot of ink amid the snow.”*

Chill indeed it is up here also, and keen and lonely. We have no one to speak to, so we pass down along the side of this lake, of which but a small portion is iceless, making our way back towards the monastery. But before entering it we have a duty to perform—to visit the mortuary, a

* S. Rogers.

THE MORGUE

place grim, gruesome, ghoul-like, and ghastly enough to chill one even on a summer day.

“ And, to incline the mind still more to thought,
To thought and sadness, on the eastern shore,
Under a beetling cliff stands, half in gloom,
A lonely chapel destined for the dead.”

The little building here spoken of as “ a lonely chapel destined for the dead ” is, in fact, a *morgue*,

“ For such as, having wandered from their way,
Had perished miserably. Side by side
Within they lie, a mournful company,
All in their shrouds, no earth to cover them ;
Their features full of life, yet motionless
In the broad day, nor soon to suffer change,
Though the barred windows, barred against the wolf,
Are always open !”

We look through a window and see a few bodies ranged against the walls, dressed just as they were found, and cramped in their death-struggle. At that altitude the bodies do not decompose, but dry up bit by bit. There they lean, in all sorts of attitudes, in all stages of decay, black, hollow-eyed, and horrible, sinking to the ground in grotesque helplessness, pathetic and repulsive.

After a short contemplation of this scene, we are glad to hurry into the almost equally cheerless monastery—the highest winter habitation in Europe, with the exception of the fourth Cantoniera on the Stilfser-Joch, or Stelvio Pass, in the Tyrol. A fine

THE CHAPEL

old St. Bernard is on the steps, and we take the liberty of warming our fingers in his close and cosy fur, for the Alpine species is of the short-haired variety.

Coming in just as darkness had settled down on the mountain ridge, we went to the chapel to hear afternoon service. The congregation consisted of but four people, of whom three were Italian, a very old, decrepit man, a woman and a young girl, probably mother and daughter. They all looked very poor, and, indeed, were entirely destitute; and as they fixed their hollow eyes on the few candles burning upon the altar, their lips quickly muttering, but inaudibly, they presented a picture of poverty, dirt, squalor, chill misery, and resignation, which brought a sigh to one's lips.

The chapel, however, is very interesting; its ceiling is entirely covered with paintings, and its walls are also embellished with them. On the central altar is one representing St. Bernard, supported by the saints Augustin (L) and Nicholas (R.), whilst above is seen the Holy Virgin, supported by angels and clouds. In the niche to the left of the altar we see a full-sized figure of St. Bernard de Menthon, the founder of the hospice. The figure to the right is that of St. Nicholas. It contains a fine dado of carved panels, date unknown.

Before the altar are two handsome seats—the one for M. le Prévôt, and the other for M. le Prieur.

THE CHAPEL

On each side are stalls (fourteen) for Canons and Fathers, and in front of these eight for the novices. All the seats are carved with angels' faces below, but are not arranged on the "tipping principle," intended to rob dozing Fathers of their service repose.

On the ceiling we see, over the altar, the Holy Virgin, St. Bernard (R.), St. Michael, St. Nicholas, and St. Augustine. In the centre of the ceiling is the Holy Trinity, symbolized by a bird, the Holy Spirit, and the Father and Son. To the right, the visit of the Holy Virgin to St. Elizabeth. There are two oil-paintings: the one, "The Last Supper," the other, "*Les Noces de Cana*." It is adorned with four handsome altars, two on either side. The organ is probably old. On the left side is a monument to General Desaix, "principal general to Napoleon the First," who was killed at the Battle of Marengo. His body lies beneath. There is a picture, by a French artist, of St. Bernard in full canonicals standing among the snow-covered mountains, with a large dog carrying a basket close beside him.

The following morning we paid another visit to the chapel. We found a few Italians, dirty and ill-clad, about to enter upon a new life in a new country, praying to the Holy Virgin for her guidance and protection. They looked very cold and very miserable as they hung over the high-backed de-

THE CHAPEL

votional chairs which do service as pews, wearing countenances at once penitential and anxious. The church by the gray light reflected from the snow looked even colder and less cheering.

“ Meek Virgin Mother, more benign
Than fairest star, upon the height
Of thy own mountain, set to keep
Lone vigils through the hours of sleep,
What eye can look upon thy shrine
Untroubled at the sight ?

“ To thee, in this aerial cleft,
As to common centre, tend
All sufferers that no more rely
On mortal succour, all who sigh
And pine, of human hope bereft,
Nor wish for earthly friend.

“ And hence, O Virgin Mother mild,
Though plenteous flowers around thee blow,
Not only from the dreary strife
Of winter, but the storms of life,
Thee have thy votaries aptly styled
Our Lady of the Snow !”*

“ Perhaps in summer there is more cheerfulness and humanity about the place,” says the writer whose unpleasant experiences we have described. “ The monastic rules imposed by the Augustinian Order are as rigid and frigid as the laws with which Nature enchains the higher Alps. In a more genial clime these may possibly be relaxed, but at St.

* Wordsworth.

CHRISTIANITY IN TERRIBLE ASPECT

not yield. Here Nature is stronger than religion, for she revenges herself on the self-tortured body by slaying it. The hospice is a battle-ground wherein the spiritual fights incessantly against the material; but if the former holds out for many years, the latter wins in the end. The soul may be saved, but the body is ruined. Yet these brave monks are worthy of the highest admiration. They live and worship amid the most appalling desolation. They do good in saving and succouring travellers from the cruelty of Nature, and they lead lives as pure and chaste as the surrounding snows. But the life is frightful. I had but one thought when I left the hospice: that for once I had beheld Christianity in its most terrible aspect."

On one side of the church is a tronc, into which guests are expected to drop what they may think fit, but certainly not less than what they would have had to pay for their night's shelter elsewhere. To us it seemed nothing less than a bounden duty mingled with a sad pleasure. Whatever it may have been—the tombs of the departed, the climatic severity, the dim light, the cold, gray cheerlessness of the great sombre buildings, or the fact that we were quite alone—we quitted the chapel depressed, with a feeling akin to sadness.

The perusal of some of the works in the library, the stroll without, and the visit to the chapel, added to the many particulars our stout Brother

A MONASTIC CONCERT

had been so good as to give us, brought the dining hour.

The *salon* of the hospice is the part least like an Alpine shelter, for it is fairly comfortably furnished and hung with pictures, the gifts of passing travellers of note. The Brother's work was light, for he had but us—his only guest—to wait upon, and thus could spend more time in talking. Of the *viands* and their cooking, perhaps the less said the better; suffice it to say that the traveller into Italy by this *route* must not expect too much.

During the repast our Brother more than once called our attention to a cottage piano in the corner of the room, impressing upon us that it was H.R.H. the Prince of Wales* who many years ago had presented it to the hospice, after having paid a visit to the good monks therein. Moreover, he inquired if we played. Though not professing much in this direction, we assented, as we thought, for his behoof alone; what was our surprise, therefore, to find that one by one, another and yet another Brother quietly came in, until some seven had each removed a chair from the great circle of them around the fire and formed a circle around us. The Brothers explained that, although unable to play the piano, with the exception of the one or two who were the hospice organists, they had all learnt singing and harmony. Happily, we managed to hit off a few things they

* Now King Edward VII.

A MONASTIC CONCERT

knew, and this was not difficult, for they were quickly able to harmonize any repeated air.

Queer enough it seemed to us to be the centre of a circle of monks, some leaning forward with eyes fixed upon the keyboard and hands fixed upon their knees, entering with earnestness and with beaming faces into the recreation.

Something in the nature of another surprise was in store for us. More than once our broad-beamed Brother had asked if we did not smoke a cigarette after dinner. We replied that we did, but that to us it appeared, if not a positive sacrilege, at least inapposite with the nature of the building then sheltering us. "Not at all," replied he; "this is the *salon des voyageurs*." So we lighted one, and, perhaps through force of habit, offered our case. Yes, the broad-beamed monk would take one, and so would the spare one with the very black, stubbly chin, which he had a habit of squeezing between his thumb and finger with a loud, rasping noise each time he essayed a question; so would another who had been full of suggestions as to airs and had brought in some manuscript music written on great, narrow, long-leaved paper, very dirty, and apparently executed so long ago that the ink was now faint indeed; so would a rotund Brother, less youthful than the others, who sat back in his chair with his hands folded over his girdle like an old maid, and had said never a word; and so, in fact, would

A MONASTIC CONCERT

they all. We fancied, indeed, by the queer way they held their cigarettes beneath the palms of their great rough and dirty hands, that it was not the *first* time they had smoked cigarettes, and this in positions where it was more necessary to whisper a *cave* than to mutter a *pater noster*.

And so the monastic concert went on, until our fat Brother, with an honest, clumsy, mourning-edged middle digit, fingered, learner-wise, a limited number of keys - so limited, indeed, that we thought it must be our loyal but tuneless "God save the Queen." It seemed so unlikely, however, that we blushed—as much for the composer as the idea—in playing it to see if perchance it could be what he desired. Yes, verily it was ; and away went all the monks, loyally and lustily, one beating time with a knuckle on the case, another with a big boot on the floor, another with the manuscript, and most with wagging heads. How many verses that same "God save the Queen" had, according to their rendering, we shall probably never know. One thing, however, we learnt from them subsequently, and this was that it *wasn't* "God save the Queen" at all, but a patriot Switzer song set to the same monotonous air.*

As time passed, so did our music pass to that of

* We subsequently learnt, which was also new to us, that our happily anonymous "God save the Queen" is also a national air of the German *Vaterland*.

THE GRILLE

higher *genre*. We tried snatches of *Faust*, of *Martha*, and of *Il Trovatore*, and in concluding the *À che la morte* of the latter a curious and effective coincidence occurred : the bell—not that of the fictitious prison, but that of the veritable monastery—commenced to ring ; and as it sounded, dull, heavy, and chill, throughout the lonely, sacred pile, so massive and so cold, the monks arose, commended us to God, severally took leave, and slowly filed out. It was their call to evening prayer. We closed the Prince's gift, and our waiting Brother, at our request and to his surprise, showed us up to bed, the chapel bell having scarce finished its booming out of nine of the clock.

As we passed up the cold gray staircase, he showed us the iron grill affixed across the corridor, through which no woman must pass. It seemed a dreadful thought that these young men were destined to live apart—an unnatural, a lonesome, comfortless, loveless life, never to know that highest of earthly bliss, the love and affectionate care of the most exalted of Nature's works—a chaste, confiding, loving wife. Such there be, and such they might appropriately worship, yet they must abjure them, for such is their religion.

22



To face Chap. VII,

BIRTHPLACE OF THE SWISS LACE INDUSTRY.

CHAPTER VII

MOUNTAIN INDUSTRIES

"Tick on, tick on ! stern monitor.
How many million ticks of ages
Since learned Galileo, Prince of Sages,
First furnished thee with pendant tail,
Bade thee predict the Comet's trail !
Tick on, tick on ! relentless monitor."*

"Tis with our judgments as our watches :
None go just alike, yet each believes his own."



CIV.

It certainly seems highly incongruous to find workmanship of the very highest order, calling forth consummate skill, mechanism of bewildering intricacy, calling forth the most unerring precision in its agglomeration, and an occupation necessitating the closest application, and this of the most sedentary and within-door kind, forming a very distinctive feature of mountains—those to which we now refer

* "The Clock," A. R. S.

SWISS CLOCKS

being the lovely Jura chain. It is in such antipodean contrast to the rural roughness, the slipshod demeanour, the elastic routine, the physical activity, and the out-of-door habitude of the dwellers in far-removed and mountainous districts. Yet this we find, and we have ventured to touch upon one such incongruous occupation, namely, lace-making.

Following the lace industry came another entailing as much delicacy of manipulation on the part of the worker, and one in which also both sexes participated, that of horology, which in its turn led on to the industry to which we now refer—that of watch-making. One form of Swiss clock is very familiar to us—"the Cuckoo"—wherein the ingenious Switzer has combined with his cheap mechanism a movement whereby the diminutive presentment of the nest-appropriating bird is made to appear with a suddenness only equalled by his disappearance and the viciously given bang of his little chalet door after each vocal performance, by which he proclaims another hour fled.

Mountain-made timekeepers have become classed under the general title of Swiss or Geneva watches, the latter name attaching to them by reason of that town having become the mercantile centre of the industry. They should, however, be divided into two distinct classes, the ordinary Swiss timekeeper of moderate price—now, indeed, produced at phenomenally low price—known the world over,

SWISS WATCHES

and the intricate and very expensive watches of the highest class, such as chronometers, accurate time-keepers, with their beautiful compensations, their stop and split seconds attachments, and their 'repeating' or chiming movements.

We will not here touch upon this watch industry* more than to say that St. Croix was once the principal village for the making of these high-class mountain timekeepers, and that the industry commenced in the middle of the eighteenth century. At first it was confined to the *cages* or *rouages*—that is, the two plates fixed a certain distance apart, in which the wheel-work is subsequently mounted, and which is technically known as the *platine*. Then this became extended to some of the heavier parts required subsequently to carry the more delicate ones, known as the *ébauches*, or blanks. In addition to these rougher parts of horological mechanism, the Switzers also made clocks, the turret clock of the "temple of St. Croix" having been made in that village in the middle of last century by a *horloger* named Bernard, which name still survives, but as manufacturers of analogous mechanism, as we shall presently see. The manufacture of chronometers and "repeaters" appears to have originated in

* This now has its headquarters a little farther along the Jura at *Chaux-de-Fonds*, but tourists going from Geneva to the Alps at Chamounix may make themselves acquainted with it at the little town of Cluses.

HOROLOGICAL APPRENTICES

St. Croix in 1752, by one Joseph Junod, called Renaud, an apprentice from Vevey, having taken back with him to the mountains a *cadration*, the mechanism in a "repeating" watch which effects the striking of the hours, the quarters, and sometimes even the minutes, upon a gong, which latter consists either of a steel wire volute, coiled round the edge of the *cadre*, or frame, so as to lie just within the *boîte*, or watch-case, or, more rarely, of a gong-shaped bell.

Up to this time the inhabitants of St. Croix had no shops—it is somewhat difficult to find such even to-day—but we are told that the lacework and the horological work brought to St. Croix a certain *aisance*, so that the villagers had no longer to journey to Yverdon for every requisite. It became the practice, too, for the youths of the village to go away to London, Paris, and elsewhere, in serving their apprenticeship to the watch-making, in order that they might learn the latest developments in the art, and these apprentices naturally brought back particulars of social progress and reform, with the result that soon little shops were opened, and even the first umbrella—said to have been a *magnifique Robinson rouge*, and we know that there are plenty of great red ones still to be seen on the Swiss Alps—made its appearance. Thus did less primitive manners come to prevail.

The knowledge brought in by the returning

ORIGIN OF THE INDUSTRY

apprentices enabled the villagers in due course to "finish" a watch completely, and in this relation it is interesting to note that to-day the principal horological work of St. Croix is the finishing, or final putting together and adjustment, of watches of the highest class.*

The beginning of this Swiss watch industry is said to have been accidental. The story runs that a blacksmith of *La Sagne*—one Daniel Jean Richard—having by chance obtained a watch and becoming engrossingly interested in its mechanism, brought his own cerebral mechanism into energetic action in endeavouring to copy it. In this commendable essay he triumphed, and succeeded in making a very good and workable duplicate of his original. Needless to say, this achievement was productive of much interest, and Richard, finding a ready sale for these useful little articles, replaced his smithy at *Sagne* by an unpretending workshop at *Petits-Monts*, near *Locle*. Before long, indeed, he had abandoned the wielding of his heavy sledge for the fashioning of metal in the tiniest of pieces, whilst the clang of

* Between two of our visits to St. Croix Messrs. Mermod made for us a watch fitted with an iridio-platinum hair spring and magnet-proof balance, with split seconds, stop movement and integrating dial, all of high class workmanship, for the exceedingly low price of but little over £5. This, after the hair spring had had time to settle down to its work, we have found to give great satisfaction, and to be most useful in recording the speed of vehicles, machinery, etc.

ORIGIN OF THE INDUSTRY

his massy anvil became subdued into the whirr of his pigmy lathe or "throw." Success was his, and so rapidly did he prosper that he was able to teach all his five sons the thus newly-imported trade, and to take as apprentices many of the young men living in the neighbourhood of his new home. From the very first the highest quality of workmanship was aimed at, and so Swiss or "Geneva watches" have come to bear a good name all the world over. Division of labour has been brought to a very fine point among the manufacturers, each watch passing through the hands of some dozens of workmen before it is sent out on its journey through the world. Nevertheless, the industry has brought about the erection of large factories, thus doing away with one of the most pleasing of Swiss winter customs, the home-working—each in his little cottage striving through the long winter days to add to his scanty earnings by the making of parts, if not complete watches.

When all Europe was convulsed with the doctrines set forth by the revolutionists at the end of the eighteenth century, some of the inhabitants of the *Locle*, having embraced the then magic formula of *Liberté, Égalité, et Fraternité*, determined to leave their homes and share their fortunes in the new Republic.

The French patriots, whatever bees may have been in their bonnets on other matters, were quick

INDUSTRY AND REVOLUTION

enough to see the advantage of getting an important industry like watch-making settled among them. Therefore they welcomed with open arms *les quatre cents patriotes* who came among them and settled at *Besançon*.

The Government ordered this district to pay from its public funds two *livres* a day for a space of two months to every workman or workwoman of this trade who would settle among them, and an extra fifteen *sols* to a married man, wherewith to feed his wife and children. Money was also granted for buying tools, etc. ; at the same time regulations were made as to the quality of the gold and silver to be used by these workmen.

Strange indeed to witness a Government with which we always associate murder and rapine, destruction and plunder, tragedies too awful for description, streets reddened by its incendiary fires, gutters running with the blood of its victims, quietly fostering with money and earnest solicitude an industry brought in from a foreign though neighbouring land.

If one reflects for a minute on what a watch is and what it does, one must be struck by the part played in life by this useful little agglomeration of wheels, springs, balance, escapement, etc. Once finished and tested, it will, under fair treatment, carry on its work for years and years. True, it is driven by our own muscles, for every night we "wind it up,"

HOROLOGICAL EVOLUTION

an operation of a few seconds, during which a certain amount of muscle is burnt up in our fingers and an equivalent amount of exertion or energy stored within the watch-case, so that for the next twenty-four hours, some 86,400 seconds, it rattles on, with its merry tick-tick marking out the flight of time and the passing of life. It lies close to our heart; each tick adds one to the past, but subtracts more than one pulsation from the heart's future.

Surely the watch is both marvellous and worthy of respect—but what of its maker? The ratio of every wheel has been thought out, every tiny component has been carefully fashioned, weighed, balanced, pondered upon and tested. Its birthplace was the fecund brain; the prepollent lucubration of the revered—persecuted—Galileo bred its possibility. His discovery of pendulous law crowned its destiny; men's brain-rackings of centuries gave it its *ensemble* of to-day. Ancestor and progeny built up its gradual perfection. Each of these men, when he had evolved an innovation, an improvement upon a former watch, accomplished a great achievement. Yet do we remember them, do we honour them, or ever give a single thought to them? Nay, we trow not. Rather, perhaps, when we misuse our honest little time-keepers, may we not be adding misery to the wraiths of those same men of genius as they see us treat their handiwork in such unfair and disrespectful fashion?

A MASTERPIECE

We recall our emotions before the great clock in Strassburg Cathedral. Standing beneath the lofty vaulting and before that unique piece of mechanism—that agglomeration of parts, that assemblage of metallic masses, intrinsically cold and insensible, a labyrinth of uncouthly-shapen fragments, each auxiliary and *utile*, yet individually inert—can one restrain analogy with our own wondrously intricate, adjustable, and beneficially compensating and recuperating mechanism; for so soon as that indefinable, inexplicable, and incomprehensible mainspring, vaguely called *life*, has “departed” or “gone out,” has “ceased to be” or has “returned” to that hypothetical *mass of soul*—according to the mode of thought of the finalist, the eternalist, or the energy-conservationist—are we not equally inert?

Standing before the great clock, placed—and worthily placed—within the massive and consecrated fane close to the inert and gaudy high altar, the thought cannot but impress itself upon us that the man who *imagined*—as the French expressively put it—that great thing must have been imbued with a special mission, the thing itself the outcome of the brain-racking of irrepressible genius, the indomitable, persevering effort of a master-mind working, not alone for material gain, but, incensed by the profound *amour de cœur* of genius, for the achievement of a task at once herculean, self-reflective—monumental.

The tourist may marvel at his work and dub

GENIUS NOT RECOGNISED

him a "genius," but will straightway carve his own name in an imbecile manner upon the stonework near the marvellous piece of mechanism, as if his name also were great enough to go down to posterity beside that of the master, in such iconoclasm treating his memory much in the same way as did the medieval citizens his body, for it is said they put his eyes out that he might not build a second for another town.* Real genius is never properly honoured, and the instance of the great clock-maker was no exception.

The making of clocks and watches in the high-perched village of St. Croix gave rise to yet another industry, one which is the feature of the place to-day, and of which, since it is one so little known, a few words may not prove uninteresting; for we were the first to be allowed to visit a musical-box factory, to make domiciliary visits, and to describe that interesting industry.

To reach St. Croix, we must hie us to the shores of Lake Neuchâtel, and then climb the Jura, a beautiful walk up through the woods, when, emerging, we find ourselves in the open, and quite close to the busy little mountain village.

"Ami, tu viens à Ste. Croix,
De ce haut pays où tu crois

* A touching romance embodying this is to be found in the German language.

SAINT CROIX

Pouvoir te plaire ;
Dans ta maison, près des Sapins,
Qui ressemble aux châlets Alpins
De feu ton père.

“Ce Jura trop peu visité
Est un charmant séjour d'été
Où j'imagine
Que tu vis de lait et de miel,
Plus heureux que le fils du Ciel
Qui baille en Chine.”*

Precisely when and how the *boîte à musique* originated is not very definitely known, but there is evidence to connect it with, and to suggest it to have been a development of, a “repeating” or striking movement. The next improvement upon the simple striking or chiming of gongs or bells was the playing of short tunes upon them by a mechanism known as a *clarion*. Clarions for heavy church bells had been known long previously, and the playing of a tune upon *lames*, or vibrating steel reeds, plucked, spinet fashion, by pins projecting from a plate made to revolve by hand, had been effected ; but the first musical-box *per se*, viz., the first self-acting melody-producer, appears to have been formed by the affixing of such a revolving plate to the mechanism of a watch, so that the tune-producer for the first time became automatic in its action.

Its fabrication by some ingenious mechanic appears to have been done for the purpose of

* Local verses.

HIDDEN MELODY

creating surprise by a person suddenly turning the clarion on when pretending to ascertain the time by his watch. It is, indeed, on record that such little chiming things were subsequently inserted into the bottoms of snuff-boxes, the tops of walking-sticks, and the like, much in the same way as miniature musical-boxes are to-day made to occupy similar positions, as well as to be found secreted in albums, in the seats of chairs, and even in the bottoms of wine-decanter, so that seekers after counterfeit presentments, after rest, and after a glass of port, alike are surprised by inadvertently turning on a softly tinkling melody.

The next step was to make the mechanism distinct from the timekeeper, and to give it its own means of movement by enabling it to store up a fragment of our own energy by the winding up of its coiled spring. Then arose a great difficulty, that of the automatic control of the *speed* of the mechanism, and, *par suite*, regularity in the rendering of the air, and it was not until an efficient means of doing this, and also of substituting for the revolving disc a revolving *cylinder*, that much head-way was made in the manufacture of what then came to be called "musical-boxes."

Such devices appear to have been introduced about the end of the eighteenth century, and we find that at the commencement of the nineteenth the industry had its birth at Geneva, whilst the

A CLOSE INDUSTRY

ever-on-the-alert St. Croixians commenced such work in 1811. From that time to the present day the industry has developed and augmented, until it now gives employment to practically the whole of the inhabitants. To-day, indeed, it forms the staple industry of St. Croix, conferring upon it the distinction of being the most important seat of such industry in the world.

The musical-box industry cannot correctly be described as either a "domestic" or as a "factory" pursuit, since even to-day, when so many mechanical operations are involved, and steam-driven factories give out their industrious hum high up on the mountain-side, whilst solely engaged in the whole-sale turning out of *parts* of the internal economy of the boxes, yet there are few, if any, homes in St. Croix in which some manual or semi-manual process forming part of the fabrication of the complete instrument is not to be found.

At sleepy Yverdun and elsewhere we had been gravely informed that to endeavour to penetrate into one of the musical-box factories would be merely time wasted, for that such were *endroits-cachetés* to us, as to all others, and would thus prove a *lettre-cachetée* to our readers. We had, however, the good fortune to make the acquaintance of Mons. Louis Philippe Mermod, head of the largest musical-box factory in Switzerland, to whom, thinking frankness the better course, we explained our

VISIT TO WORKS

desire, and also the nature of our own profession, which might make the disclosure of any mechanical operation it might be desirable to keep as a "trade secret" doubly dangerous. To our surprise, probably out of respect for our readers, he acceded to our request to study the processes involved, and was assiduous in his endeavours to explain the



CV.

manufacture, taking us through the works step by step in the wake of the work itself, as it mounted higher towards the roof and towards its own completion.

At the same time, where necessary, we were conducted into shops and cottages, where alone the connecting links of the mechanical chain of pro-

THE COMPONENTS

cesses could be seen in the forging. The result of a pleasant day spent with this gentleman we will endeavour to give in describing this mountain industry, the manufacture of musical-boxes.

A description of the mechanical processes involved must of necessity verge upon the technical. Nevertheless, so interesting did we find them, and so painstaking were the Swiss workers in instructing us, that we have ventured to lay a complete description before our readers.

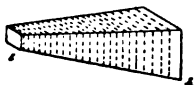
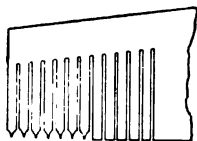
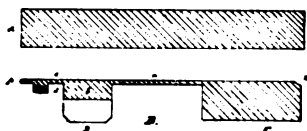
At the outset we have to ask ourselves, and to obtain answers to, three questions: Of what does a musical-box consist? how does it produce its music? how is it made? Replying to the first, a *boîte à musique* consists essentially of four principal things: its motive-power-imparting agent—that is, its spring or *ressort*; its sound-producing agent—that is, its “comb” or *clavier*; its tune-producing agent—that is, its pin-studded drum or *cylindre goupé*; and its speed-controlling or governing agent—the “fly.”

Of these, the first and last are the least specific—albeit of much importance, being but springs and trains of wheel-work, devices employed elsewhere; whilst the remaining two—the comb or *clavier* and the cylinder or drum—are of the essence of the mechanical combination as well as those requiring the greatest accuracy of manufacture and the greatest skill and patience in the making.

The spring does not differ materially from that of a clock, consisting of a thin tape of elastic steel enclosed within a drum capable of being powerfully coiled up, and of uncoiling at a slow and prearranged speed of very approximate uniformity. This control of the speed is effected by causing the revolution of the drum enclosing the spring to impart motion to what is known as a multiplying train of wheels—a number of “tooth” wheels

THE "FLYER"

gearing the one with another and so disposed—as regards their respective diameters— that the slow motion of the edge of the spring drum is converted into an exceedingly rapid motion of the little "butterfly," or flyer, which one sees whirling around at such speed that it can be seen only as a yellowish haze within its little support or "cock" in the completed box. The spindle of this rapidly flying "butterfly" is made in the form of a corkscrew, technically known as the "worm," and one convolution of such corkscrew rests upon one tooth of a small wheel, known as



CXL.

the worm-wheel. To keep these convolutions in "gear" with the teeth of the worm-wheels, the flyer is carried in suitable bearings, and the pressure with which it is thrust upwards by the force of the spring is taken by a ruby, or, in more modern boxes, a piece of intensely hardened steel, approaching, indeed, in hardness to that of the diamond. The pressure of this ruby upon the flyer spindle is adjustable, as also is the "splay" of the wings or flyers, and by these means the speed of unwinding of the spring, and with it the

rotation of the cylinder, and hence the "time" of the melody, is controlled at will.

Speaking from the musical side, the piece of paramount importance in the box is the comb. This consists of a somewhat massive piece of steel slit up at a number of places along its length (see cut) by cuts penetrating to a greater or lesser extent, leaving portions of the steel projecting as "teeth," and these subsequently become the *lames* or vibrators, to which we are solely indebted for the musical sounds produced.

THE "CLAVIER"

Looking into the musical-box, with its bright comb, technically known as the *clavier*, the teeth of which are being continually lifted up carefully and as suddenly dropped, now here, now there, with bewildering uncertainty and a promptness it is impossible to follow, it would scarcely strike the casual observer that the production of this dentated piece of steel involves no less than seventy distinct operations from the time it arrives in the works from smoky Sheffield until it leaves them enclosed in its ornamented *cadre*. To recapitulate the seventy operations would, we fear, weary the reader, but we will refer to a few. At first the crude piece is very thick, and this we will represent in section by AA (CVI.). It has already been cut to the correct dimensions appropriate to the size of musical-box for which it is eventually to provide the clavier. It is now placed upon a machine, known as a milling-machine, in which a broad steel wheel, provided with numerous sharp teeth or cutters, over which oil is continuously streaming, cuts out a set of three grooves from beneath its under-side, imparting to it the section shown at B. This has a fourfold effect: it so reduces the thickness of the plate at *a* that, when cut into teeth, it will vibrate; it is provided with suitable projections at *b*, to which can be conveniently attached blocks of lead, so weighted as to bring the speed of oscillation of such tongues down to that required for the particular note; thirdly, it suitably thins the front edge of the plate at *c*, that it, as teeth, can be lifted and dropped by the pins of the revolving cylinder; whilst, fourthly, it provides, at *d*, a groove into which the points which are to engage with the cylinder-pins can be riveted, a portion of its under-side at E being left to support it upon the under-frame or bed of the box.

Then comes an exceeding long and tedious process, the cutting of the teeth, effected by means of revolving circular saws, these being of necessity very thin. Obviously, the spaces between the grooves thus cut must be preserved with the greatest exactitude, for each one of these constitutes a "note" or vibrator, and to mark the hard steel where it is to be slit would be difficult and

CUTTING THE TEETH

a not very mechanical expedient. The clavier is therefore fixed in a frame, known as a "slide-rest," in front of the cutter (CVII.), and this sliding rest can be advanced the exact distance required after each groove has been cut by turning a "leading" screw a certain prearranged amount, according to the broadness desired. This operation is shown in one of the photographs kindly taken for us by our host and here reproduced. The block of steel has now to be thinned at *a* by hand-filing, and this needs to be done with the greatest accuracy, for upon this thickness depends the "pitch" of the notes. If it be too thick the notes will be too



CVII.

shrill; if it be too thin the tones will be too *grave*. Then the treble notes have to be specially thinned and attended to, for these, vibrating at a very high rate of speed, require especial care. This work we also see the *ouvrier* occupied in in our illustration (CVIII.).

The clavier, having been cut up into teeth, now presents the appearance shown at the lower part of Fig. CVI. Another process is to form the points on the teeth. This is also effected by suitably-shaped revolving cutters. Up to this stage the block of steel has remained black. It is now ground upon an emery wheel revolving at a great speed, which tears off the particles of steel, and sends them flying across the room like a continuous fiery "squib." The block, now bright, but not polished, is afterwards placed in a planing-machine, and its under-side at E planed true, so that it will fit down properly on to its bed. The broadness of the teeth is now adjusted with great care, and then the clavier is hardened, viz., heated to a high

shrill; if it be too thin the tones will be too *grave*. Then the treble notes have to be specially thinned and attended to, for these, vibrating at a very high rate of speed, require especial care. This work we also see the *ouvrier* occupied in in our illustration (CVIII.).

The clavier, having been cut up into teeth, now presents the appearance shown at the lower part of Fig. CVI. Another process

TEMPERING

temperature and plunged into water. It is now said to be "dead hard," and has to be "let down" or "tempered" to a slight but definite degree. At first sight this would appear to be a very difficult operation, for how can the degree of hardness be ascertained? This is ascertained in an indirect manner, as follows: After the block has been heated and immersed to "dead hard" it is much tarnished. A portion of it is now ground bright, it is again heated to a moderate degree, and plunged into oil, to a greater or lesser extent, and for a longer or shorter time, as the "temperer" elects, his decision being made by carefully



CVIII.

watching the ever and rapidly changing *hue* the bright surface presents, stopping it at the requisite moment by complete immersion in cold oil.

Now, it is found that the accuracy of the spacing of the teeth has been destroyed in the process of tempering. The tongues have indeed become "warped." This has now to be carefully rectified. But the metal is no longer in that temper of kindly malleability to brook much interference, and thus it happens that in several cases out of every dozen a tooth, or teeth, are broken

FIXING THE "DAMPERS"

out. These have then to be replaced by new ones "brazed" on to the massive comb-back.

Now the leaden weights or "dampers" (D) have to be affixed, and this is done in the following manner: A piece of lead is taken equal to the whole length of the clavier, shaped as shown in the cut at L, L. This block is tapering both as regards its thickness and its width, so that it can be afterwards cut up into separate "dampers," as shown by the dotted lines. This is then "soldered" throughout its entire length to the clavier, the whole again mounted upon a cutting-machine, and the lead cut up nearly into separate strips, just as the steel teeth had previously been formed. It is found impracticable to cut the lead entirely through in the machine, and another process, about the twenty-second, is to dexterously sever the separate weights with a tiny hand-saw. The under-side of the comb is now *ground* at E, so that it may be properly joined to the brass bridge upon which it is to be mounted. Then it is drilled with holes, through which the large-topped screws we are all familiar with are to pass to screw it tightly down.

Now comes an exceedingly difficult operation—the drilling of the holes at p to receive the "catch" pins; then a still more difficult operation, the drilling of the still tinier holes to receive the microscopic "dampers" at d, little pieces of very thin steel wire—thin, indeed, as hairs. These are placed there to prevent the unpleasant "buzzing" or "wheezing" sound often heard in boxes in which some of these are missing, and which is caused by the tooth in its vibration touching the next cylinder-pin as the latter comes up beneath it. Now the bridge is soldered to the comb and then drilled. The clavier is then flattened or "platted" beneath a stamping-press; then its back edge is bevelled at z.

It is now approaching completion, but it is still rough, and contains many hammer-marks, so it is again twice ground, the emery wheel employed for the second grinding being of much *finer grain* than the first. Finally it is polished, washed, brushed in petroleum, and slightly but carefully greased. And now at last

THE CYLINDER

the clavier, which has cost so much in time and skilful manipulation, is put away into store, to be subsequently affixed on the "bed-plate" of some box in which it will discourse sweet melody at the behest of some chosen cylinder of congenial form, to which it will be wedded for life.

The completing of the clavier brings us to that all-important member of the *boîte à musique's* anatomy, the cylinder or drum, and this cannot receive its finishing touches within the factory until it has made one or more peregrinations beyond them to have *many* an hour spent on it "at home" ere its music-provoking pins can be brought into communication with the clavier's asperous fingers. It is scarcely necessary to point out what an important member this cylinder is, the very soul and mind of the instrument, from which all harmony springs, and any derangement or aberration in which—even the most trifling—is at once manifested in unwonted unmusical emanations, be it by a dissonance, an imperfect rhythm, a faulty harmony, or a broken melody. The skill required to produce it can be vaguely imagined when it is mentioned that in the larger instruments a cylinder often carries as many as 35,000 pins, each one a note, and each note in its allotted place, true to the hundredth part of an inch.

How these pins are arranged, marked out, spaced, grouped, put in, cut to exact length, curved and adjusted, forms an interesting study. The cylinders themselves are made in the works, and seeing the perfection to which the "drawing" of tubes out of a solid mass has attained, we should at first sight expect to find them made from a length of such brass tubing. This, however, we were informed cannot be made use of, from the fact that it has, through being drawn *through* a steel "die" and *over* a steel rod, known as a "mandril," a slight "batter" or "taper" upon it—that is, that it is *slightly* larger at one end than at the other, though imperceptible, a circumstance fatal to the employment of "drawn" tube for musical-box drums. Consequently, a piece of flat sheet brass has to be taken, "planished"

MUSIC AND MECHANICS

plane, and rolled up between bending rolls into a cylinder, and its edges brazed together. It then has its ends put in, and is turned true in a lathe, and finally scored with a number of lines passing entirely around it, which lines exactly correspond with the positions to be subsequently held by the points of the clavier. Now, these lines correspond to the position of the first tune in the cylinder's repertoire, and every note of that tune must be just and exactly on that particular line ; any note to right or left of that line, no matter how slightly, will fail to "speak," and, in fact, belongs to another tune. But we should not be content if our box were incapable of playing a *selection* of airs. Where are to be placed the pegs upon which the tunes of this selection are to be hung ? It is obvious that all these, no matter how numerous, must be squeezed in between the points of each pair of teeth adjacent on the comb. On account of their proximity, the cylinder is *not* scored with lines representing these tunes, for the simple reason that it would be bewilderingly *full* of such lines. How, then, can the positions of these thousands of pegs be marked upon the cylinder, and, moreover, how are these positions arrived at so that in their plucking of the clavier tongues they shall produce the melody ?

In the first place, a piece of music must be chosen of such a length that it will just reach *once* round the cylinder, and *no more*. In other words, it must contain a given number of "bars," for the cylinder revolves just once in a given number of bars or beats, and the tune may fall short of these, but it *cannot* exceed them. Then there comes in a preliminary problem for the *musician*. *He* must so arrange, alter, and manipulate the composer's work that, whilst adhering as nearly as possible to the author's wishes and intentions, his work shall be performed in one revolution of the bristling drum. Thus arranged in special musical-box manuscript the airs are given out to the marker, whose sole business in life is to transpose from paper to brazen drum the familiar dots, the open eyes and the closed eyes, the minims, crotchets, quavers, and "dami-semiquavers," as the tired student is apt to

THE MUSICAL MAP

call them, of the ordinary musical notation, which so bewilder our little ones when they first enter upon the drudgery of the "divine art." But this is not all: he, the *marquier*, has to space the notes along the line exactly in proportion to their musical or time value. Thus, a minim must be just twice as far away from her friend the crotchet as his neighbour the quaver is from himself.

To the quietly working cylinder-marker in an upper room, to whom we are taken, and whom we see in our photograph (CIX.),



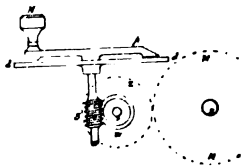
CIX.

each beat of the conductor's *bâton* represents but a definite fraction of the circumference of the drum, so many millimetres or fractions thereof measured off along the afore-mentioned lines encircling the drum. From the above observations, it is clear it would be nothing short of criminal to call upon him to map out the surface of the cylinder for the reception of its thousands of pins, exactly where and when requisite, without at the same time providing him with all available mechanical aids, in order to minimize as far as possible the mental strain arising from the

THE DIVIDING ENGINE

solicitude and anxiety unavoidably experienced by an *ouvrier* so engaged in endeavouring to avoid errors—unwonted deviations—which may easily enough creep in, though he may bestow upon his work the most assiduous and unremitting care and attention.

We therefore find him standing before a machine, known as a “dividing-engine,” the duty of which is firstly to enable the drum to be advanced, both laterally and circumferentially, to the exact position where a pin is subsequently to be inserted, and then to legibly mark it and to form on the surface small indentations, which shall form the “leads” or recesses into which the drill of the driller will afterwards be brought down. For these purposes the “dividing-engine” is constructed in two distinctly



cx.

acting mechanisms, the first for bringing the cylinder into accurate position, the second for making the little dots or “countersinks,” the latter consisting merely of a very rapidly revolving *stylus* or steel “counter-sink,” held in a frame which may be depressed at will by the “marker.”

The very important and accurately adjustable “marking” portion of the “dividing-engine” will be made easily intelligible by the sketch (cx.).

A dial (*d d*), only the edge of which we are able to see, is divided into a number of divisions, corresponding both to notes of given length and, obviously, at the same time advances of given length of the circumference of the drum. But how can these advances be made with absolute accuracy through such necessarily very minute distances? This the sketch will render clear. Above the graduated dial is a pointer (*p*), which at its other end carries a handle (*H*), by which it can be conveniently turned round. The spindle of the pointer has cut upon it the “worm” or spiral (*S*), and this spiral is in gear with the “worm-wheel” (*w*), which in turn is firmly fixed upon a rod passing

THE MUSICAL CHART

along the back of the temporarily supported cylinder. The wheel (W) is temporarily affixed between points on the "engine" by its spindle (*r*) to a "tooth-wheel" (Z) at the other end of the music cylinder, and shown in dotted line. This, again, is in temporary gear with the permanent teeth of the cylinder (M, M), also shown in dotted line, which itself is swinging between "centre" poppets by its arbour (K). Now, it will be seen that the turning of the handle (H) will have the effect also of turning the cylinder, which may thus be made to rotate, progressively or retrogressively, according to the direction in which H is turned, and to an extent greater or lesser, according to the angle through which the handle H is moved. But the reader will also appreciate at once that by suitably proportioning the wheels and the worm-spiral a large and coarse movement of the pointer may be made to correspond to the finest and most minute adjustment of the cylinder.

Having watched the careful marker as he—with considerable speed, having regard to the delicacy of his task—gradually covers the surface of the bright cylinder with a veritable musical chart, in which the sinuous outlines of the continents will presently give rise to undulating cadences of sound, oceans will produce spaces of tranquillity, whilst archipelagoes of islands will awaken powerful musical chords, we proceed to see the smooth surface of the cylinder pass through its next process and the drum become a roller literally bristling with *cheveux de frise*, studded, indeed, in the greatest profusion and intricacy with thousands of the tiniest of pins. For this purpose we must follow it beyond the walls of the works, for such process constitutes one of the "home" links of this interesting chain of manufacture.

To be instructed in the *modus operandi* involved in carrying this important process into effect, we were led off to the other side of the village and introduced to just such another Swiss interior as we have pictured in regard to the domicile of the busy *denteleuses* of days gone by. It was a bedroom, scrupulously

THE OUVRIER'S HOME

clean, cosily and comfortably furnished. The old wooden bedstead had upon it a snow-white coverlet; from the wall projected a turned piece of mahogany, finished with a 'turned mahogany rosette, the work of the village turner; and over this depended to head and to foot a curtain of printed calico. The floor was of hexagonal red tiles, polished up to the sheen of a ballroom floor, and in the centre of this was a small square of carpet. The weather was bitterly cold, but the room was comfortably warmed by a wood fire within a closed *calorifere* of white tiles. The



CXI.

walls were embellished with coloured oleographs in home-made frames of reeds, and illuminated Scriptural texts in frames of plaited buff paper. Above the bed hung an elaborate needlework "sampler," reminiscent of the wife's school-days. A Swiss clock, carved to represent a native *châlet*, loudly ticked out the fleeting seconds with a vigorous wagging of a short wire pendulum, carrying as its "bob" a brazen sun's face. The walls were of terra-cotta distemper, the ceiling of timber. Hanging inside the window, and tacked to the sash, was a white muslin curtain, behind this a row of plants in bright red painted pots, and

THE OUVRIER'S HOME

behind these, again, at a narrow board fixed upon the window-sill, sat a couple of workers—mother and daughter. The former, a buxom girl with raven locks, wore a neat blue blouse and stuff skirt; the mother was in a gray stuff dress. Having obtained permission to learn their trade, we were attentively leaning over their shoulders, when we found our “knickers” tugged at with vigorous little tugs, and, looking down, found that “baby” had crawled out from some hidden recess, and was obviously desirous of patronage. This we accorded him—we presumed it was a “him” by his bright and chubby features and the strength of his tugs—but did not risk an allusion to his gender in asking to whom he belonged. It is very difficult for a bachelor to talk or write about babies. The response, however, brought a slight blush and a happy smile to the face of the proud and happy bread-winning mother, whilst grandmother appeared not to heed, but, we are persuaded, took in the situation with the utmost satisfaction. The young mother continued uninterruptedly with her drilling—for they were “drillers” and “pinners”—whilst the elder explained both processes.

It will be remembered that we saw the cylinder ready to leave the factory, with the positions to be occupied by the pins ready marked upon it. The next two processes are (1) to drill the requisite holes and (2) to insert the pins. Both of these operations we were to see carried out in this neat bed-chamber. The daughter was the *perceuse*, the mother the *goupilleuse*, for her duty it was to “plant” the pins or *goupilles* in the holes drilled for their reception by her daughter.

It is clear that the only duties the drilling-machine had to perform were (a) to hold the cylinder lightly, and in such a manner that it could be easily turned, so that the marks might be readily brought under the drill; and (b) to enable a drill to be inserted into the position marked by the depression previously made by the “countersink” of the “marker” at the factory, and the cylinder thereby pierced.

THE PERCEUSE

• This cylinder drilling-machine worked by the young woman was most primitive in design, and consisted of a rough lathe-bed, upon which stood a couple of poppets provided with points, between which the cylinder was placed so that it could be turned at will merely by grasping it directly by the fingers. Carried upon a wrought-iron standard arranged above the cylinder was a little "drilling-head," with its drilling spindle revolving at a very high speed by means of a thin whipcord band driven round by a fly-wheel and treadle worked by her foot, and invisible beneath the bench.

The cylinders when brought to the cottage being already marked, these two cottage operations are the drilling and the pinning of the drums. For this purpose a tiny "drill"—far thinner than an average sewing-needle—is put into the rapidly-spinning drilling spindle. This is held up out of contact with the cylinder by a spiral spring. From the vertically sliding drilling-head a light lever projects, and from this hangs a small loop of whipcord. Into this noose the young woman puts the index-finger of her left hand, whilst with the remaining fingers and thumb she grasps the cylinder, and turns it a slight fraction until the spot marked is approximately under the drill. This latter she holds between the index-finger and thumb of the right hand, almost as one holds a pen, and so soon as its position corresponds with that of the mark, she depresses the whipcord and lever by the first finger of her other hand, and the hole is quickly drilled, as, indeed, it need be, considering the thousands to be drilled in even the cheapest of boxes. All this is very clearly shown in the photograph (CXI).

As for the pins themselves, these are made of exceedingly thin steel wire for the boxes of ordinary size, the wire being slightly thicker for the larger ones. The wire is first cut into convenient lengths—about 10 inches—and these pieces are placed in a little machine for the purpose of being cut nearly through by a special saw-edged file, a useful operation, as we shall soon see. This machine has a simple ratchet movement, so that the

THE GOUPILLEUSE

thin wire can be quickly advanced the exact length required for each pin, and then a couple of strokes of the file, held lightly against a suitable rest, expeditiously does the partial severing.

The mother's work, as we have said, consisted in fixing the pins into the holes drilled by the daughter. This operation she performed as follows: Having prepared a bundle of partially-cut-through wires, she would pick up one in a pair of forceps and dexterously insert it into a hole; then, with a smart lateral jerk of the wire, snap it off at the first file "nick." This is called "planting," and when a dozen or two *goupilles* had been so "planted," she, with a deftly-dealt blow of a light iron mallet, drove them in just so tightly as to prevent them falling out. She then took a hollow punch, which, however, was only drilled up the exact length it was desired the pin should project out from the cylinder, and with this she drove them all in to a uniform length.

The cylinder is now bristling with its pins, and has to pass onwards into other hands for *vérifiage* and into another domicile. Thither we followed it, which was into a little parlour behind a rural haberdashery store. This process is one of considerable responsibility, and one requiring both skill and thoughtful care, for upon it depends entirely the correct rendering of the music by the completed instrument, and if this be defective, it necessitates the complete dismantlement of the mechanism before the *vérifiage* can again be taken in hand. In this small room, piled high on all sides with boxes and little drawers, filled with the multitudinous heterogeneous requisites of the fair sex, numerous even in this workaday village—for what *goupilleuse*, *marqueuse*, *perceuse*, or *vérifieuse* would work so diligently, did she not know that her surplus so gained would enable her to cut as fine a figure at church on Sunday or at Isabel's wedding as her *conscœurs*?—in this little "store" we found a neatly-dressed woman with iron-gray hair sitting at her bench by the window engaged in this noiseless operation. Her work at that moment consisted in

THE VÉRIFIÈREUSE

verifying one of those giant cylinders required for an "exhibition" instrument. Her duty was threefold: firstly, to bring the groups and lines of pins corresponding to each tune *exactly* opposite their own tongue of the clavier; secondly, to bend the pin so that it should point upwards at the moment it meets the *clavier*, as shown in the sketch (CXIII.); and, thirdly, to give each note its true value by increasing or diminishing the distance of its point from that of its neighbour. In order to carry out this verifica-



CXII.

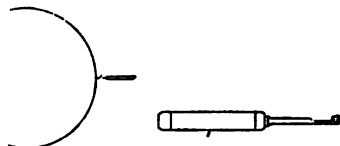
tion of the tune, she had before her the music—in the ordinary notation—whilst above the teeth of the comb was fixed temporarily the scale marked in *ut, ré, me, fa*, etc. The verifying machine need not be described, since it was practically the same as the "marking" machine with the marker absent—that is to say, a machine capable of imparting very small and very accurate circumferential movements to the drum. The correct position of the notes laterally was ascertained by presenting them to the comb, whilst their time value was verified by advancing the cylinder in rotation by a micrometer screw, so geared that one turn of its milled head gave the spacing for a black note, two

THE VÉRIFIÈREUSE

turns for a note of double the value—an “open-eyed” one—etc., and fractions of a turn, were it a quarter, an eighth, etc., for those of lesser time value. The accuracy of the chords was verified by observing if all the pins of the same chord engaged with their prongs exactly at the same instant.

In this relation a question will probably arise in the mind of the reader, What arrangement can be adopted to produce a very rapid succession of notes in a quickly executed repetition passage? for it is obvious, firstly, that the speed of rotation cannot be increased; secondly, that the pins cannot be placed sufficiently close together; and, thirdly, that if they could, there would not be space between them for the tongue to vibrate, for naturally in its first excursion it would strike the succeeding pin, and a buzz instead of a tone ensue.

This difficulty is got over by having in the comb more than one tongue of the same pitch, more than one vibrator for the same note. These duplicate



CXIII.

tongues are frequently neighbours, but in the larger boxes, as one has often noticed, several combs are made use of thus. This obviously adds to the difficulty of the “verifier’s” task, for then the air is divided into two or three sets of notes, some of which are taken by one and some by other of the tongues of the same name and pitch. Before the pins are finally adjusted as to position, they are first bent at an angle to the surface of the cylinder, so that they engage their respective tongues with their tips rather than with their sides, as shown in the sketch. This, it will be observed, provides a clearance for the vibration of the tongue immediately it has disengaged itself from contact with the *goupille*.

For this purpose our instructress made use of a tool shaped as in the sketch, consisting of a handle (*h*) carrying a shank turned up and drilled with a hole corresponding in diameter to the

VÉRIFIAGE

gauge of wire of which the pins of the particular instrument were made. It was called a *courbette*, signifying an instrument for *curving*, and was used by being pressed down to the root of the pin and then held over to the angle required to be taken by the pin.

The skill with which the various operations of this *vérifiage* was performed was indeed remarkable. The micrometer-graduated head was turned by the left hand, and was stopped over the graduations with remarkable promptness and exactitude, without



CXIV.

the operator once looking towards it or taking her eyes off the pins under verification.

The pins having been inserted and accurately adjusted, the cylinder goes back to the works, for it now has to pass through an operation performed by an artisan of the masculine gender. His work consists in reducing the pins to a uniform and exact length ; or perhaps it would be more correct to say that he files down all pins until the point of each and every one stands at the

FINISHING

exact same distance from the *centre* of the cylinder. An instant's reflection will serve to impress upon us of what paramount importance this finishing of the points so that they shall all occupy *exactly* the same position in regard to the points of the comb is to the proper rendering of the melody of the box. If, for example, one be by the minutest space *shorter* than the others, it will fail to lift or pluck the tongue apportioned to it, and that will obviously remain mute. On the other hand, if it be in the



CXV.

least too *long*, either it or the tongue will be broken, or at least the tongue will be dropped too sluggishly, and consequently the note sounded too late. As a matter of actual practice, no greater irregularity of surface than the one-fiftieth of a millimetre—less than the thousandth of an inch—is permitted. To accurately accomplish this, the cylinder was placed in a “levelling” frame and carried upon bearings which could be exactly adjusted by being raised and lowered upon graduated micrometer-screws. The

TUNING

points of the pins by the rotation of the drum were then filed off to an exact cylindrical surface. The length of time occupied in this process, which is shown in one of the photographs (CXIV.), somewhat surprised us. For a small drum a couple of hours are needed, whilst for those of the largest size no less than twelve hours must needs be spent upon the adjustment of the length of their pins.

We have now described the principal processes entailed in the manufacture of a musical-box; it only remains to put it together. The "assemblage," "tuning," "incadring," and "ornamenting," are all carried out in the works.

We left the all-important clavier just finished there, but before it can be put into position in its box it has to be tuned. This is an exceeding simple process manually, but one requiring exceptional sensitiveness of ear on the part of the *accordeur*, for the particular tongue of the comb is merely "twanged" by being made to slip off a piece of steel held in a vice, and to this very feeble and unmusical sound—for it must be remembered that in no instrument does the actual vibrating piece or string emit but a very small fraction of the sound, the useful volume being due principally to the "sound"-board—to this little twanging buzz the tuner listens, and then either renders it more acute, by filing the tongue near its extremity, or more grave, by thinning the



CXVI.

tongue down near its root. If the error be considerable, he first shaves off with a sharp knife a piece of the lead "damper"; then a finer adjustment brings the clavier eventually into tune.

In commencing with the crude comb, in order to distinguish the notes, a brass ruler marked with the scale in *ut*, *ré*, *mi*, *fa* is placed temporarily under the clavier, but when the *gamut* has been approximately made this is removed. In both the operations, it was interesting to note, no "standard" of any kind was had recourse to. The accurate fixing of the clavier opposite the pins was another careful process. It was first

CHEFS-D'ŒUVRE

fixed in position by dowel-pins ; then the cylinder was very carefully rotated by hand, when it would be found that some of the teeth of the comb were still not quite accurately spaced. These errors have to be rectified by the tongues being "burred" over by dexterously-given blows of a narrow-nosed hammer. That this work of the *poseur* is of great importance may be judged from the fact that the width of the points of the comb does not exceed a quarter of a millimetre, whilst into the small space between each pair of neighbouring points the whole of the tunes—perhaps a dozen—have to be squeezed. Obviously, the slightest irregularity of "pitch," or distance of the tongue, or the minutest lateral motion of the drum, would be fatal to the correct rendering of the music.



CXVII.

As for the drum itself, this requires but one process after the "truing up" of the pins. It is polished and lacquered, and sometimes nickel-plated, and whilst still warm a quantity of shellac is poured into its interior whilst it is revolved, for this has the effect of fixing the pins. The mounting or assemblage of the mechanism is similar to ordinary horological assemblage, and need not be described.



CXVIII.

The magnitude to which the industry has grown, the variety, refinement, forms and sizes, in which the *boîtes à musique* are now procurable, are alike surprising, some constituting quite automatic orchestras.

Needless to say, we were shown many interesting *chefs-d'œuvre* in the form of exhibits returned from

ADIEU

exhibitions, where, judging from the shields upon the walls containing medals awarded, such must often have been displayed. Musical snuff-boxes, walking-sticks, bottles, decanters; boxes out of which tiny birds hopped, and, with fluttering wings, piped a short song and popped back, with a decisive slam of the little door; large clowns, whose heads nodded and winked at one in true "Sanger-like" fashion as the box surmounted discoursed appropriate airs, were among the *chefs-d'œuvre* of this interesting mountain industry.



CXIX.

The visitor who may come up to visit this industrious little mountain town should not descend again without first climbing to the top of the Grand Chasseron just beside him, and this, if possible, at either sunrise or sunset. The local poet asks :

"As-tu vu le soleil levant
Du Chasseron, dôme où le vent
Souffle sans cesse ?"

Gentle reader, if thou hast not—do !







To face Appendix I.

TOURISTS ABOUT TO CROSS A GLACIER.

APPENDIX I

GLACIERS AND THEIR MOTION

"A truly magnificent spectacle is this motion, so gentle, so continuous, and yet so powerful and so irresistible."*

"THE world of ice and of eternal snow, as unfolded to us on the summits of the Alpine chain, so stern, so solitary, so dangerous, it may be, has yet its own peculiar charm. Not only does it enchain the attention of the natural philosopher, who finds in it the most wonderful disclosures as to the present and past history of the globe, but every summer it entices thousands of travellers of all conditions, who find there mental and bodily recreation. While some content themselves with admiring from afar the dazzling adornment which the pure luminous masses of snowy peaks, interposed between the deeper blue of the sky and the succulent green of the meadows, lend to the landscape, others more boldly penetrate into the strange world, willingly subjecting themselves to the most extreme degrees of exertion and danger, if only they may fill themselves with the aspect of its sublimity.

"I will not attempt what has so often been attempted in vain—to depict in words the beauty and magnificence of Nature, whose aspect delights the Alpine traveller. I may

* Helmholtz.

APPENDIX I

well presume that it is known to most of you from your own observation; or, it is to be hoped, will be so. But I imagine that the delight and interest in the magnificence of those scenes will make you the more inclined to lend a willing ear to the remarkable results of modern investigations on the more prominent phenomena of the glacial world. There we see that minute peculiarities of ice, the mere mention of which might at other times be regarded as a scientific subtlety, are the causes of the most important changes in glaciers; shapeless masses of rock begin to relate their histories to the attentive observer—histories which often stretch far beyond the past of the human race into the obscurity of the primeval world; a peaceful, uniform, and beneficent sway of enormous natural forces, where at first sight only desert wastes are seen, either extended indefinitely in cheerless, desolate solitudes, or full of wild, threatening confusion—an arena of destructive forces. And thus I think I may promise that the study of the connection of those phenomena will not only afford you instruction, but will make your pleasure in the magnificent scenes of the high mountains more vivid, your interest deeper, and your admiration more exalted."

In these words—apparently springing from the very soul—did the most learned philosopher of his time* refer to the Alpine glaciers and their motion. The great savant opined that the magnificence of the scenes amid the mountains—such as those to which we have ventured to advert in the preceding pages—would make his hearers the more inclined "to lend a willing ear" to the remarkable results of scientific investigation in this relation. May we therefore venture to hope that a short exposition of such investiga-

* Professor Helmholtz in his opening lectures upon "Ice and Glaciers," delivered at Frankfort and Heidelberg in 1865.

APPENDIX I

tion, devoid as far as may be of technicality, may also command the willing attention and interest of our readers who may have honoured us by following us thus far?—for among the many phenomena prepollent to give rise to most pleasurable study amid the glorious Alps, certain it is, there is nothing more entrancingly interesting than glacial motion.

Nothing would be farther from one's thoughts—high up in the silent solitude of the mountain fastnesses—than that those vast masses of solid ice, hundreds of feet in depth,



FIG. 1.—The Moraine Hut of Professor Hugi.

hundreds of yards in breadth, should be moving. Centuries and centuries, indeed, passed away before the discovery was made. When, however, the questionings of scientists, why the great ice-fields should not go on increasing in height and extent indefinitely, began to be answered by the discovery that the vast masses were really rivers of ice gliding down the mountain sides, students of physics commenced the arduous task of measuring their motion. Among those scientists who have at great personal risk, discomfort, and privation communed with the chill glaciers

APPENDIX I

and brought their phenomena and idiosyncrasies within the domain, as it were, of the exact sciences, must ever stand out the names of Agassiz, Forbes, and Tyndall.

A minute study of the history of glacial research might not interest the general reader, nor that of the minutiae of the various phenomena exhibited; but we feel that a short reference to the formation, mode of motion, and disappearance of these wondrous masses, and the great work done by them in the sculpturing of Nature, cannot fail to be of interest.

On the great medial moraine formed by the junction of two branch glaciers, the Lauteraar and the Finsteraar, which unite at a promontory to form the trunk glacier of the Unteraar near to the Grimsel Pass, so long ago as 1827 an intrepid and enthusiastic Swiss professor, Hugi, of Solothurn, built a hut with the object of making observations upon the glaciers. But he found that his hut *moved*. And, like the scientist that he was, he arranged to measure its movement, with the result that he found in three years (1827-30) it had moved 330 feet downwards, or rather more

than 100 feet each year. In 1836 it had moved 2,354 feet; whilst it was found in 1841—by another scientist, Agassiz—to be 4,712 feet, or close upon a mile farther down than the point at which it was first erected. Thirteen years after the erection of the first hut,



FIG. 2.—The Glacial Abode of Agassiz and other Intrepid Scientists.

Agassiz and some bold companions constructed a shelter under a great overhanging slab of rock, to which they added side-walls, on the same moraine. As the *coterie*

APPENDIX I

hailed from Neufchatel, this subsequently became christened the *Hôtel des Neuchâtelois*. Careful measurement showed in 1842 that the "hôtel" had moved 486 feet in two years.

All this was most interesting, and led to the determination to enter upon more systematic investigation of this remarkable motion. Monsieur Escher de la Linth attempted to determine the movement of a series of wooden stakes driven into the Aletsch gletscher, to which we have more than once referred, but the melting of the ice was so rapid that the staves soon fell. To remedy this source of failure Agassiz, in 1841, undertook the great labour of carrying boring-tools up to his "hôtel," and piercing the surface of the Unteraar glacier at six different places to a depth of 10 feet, in a straight line right across the glacier. Piles were driven into these six holes so firmly that they remained in the ice for a year, and when measurements were about to be taken of their movement the astonishing fact was observed that they had all moved different distances. Thus the first had advanced 160 feet, the second 225 feet, the third 269 feet, the fourth 245 feet, the fifth 210 feet, and the sixth and last 125 feet. This was most surprising, but an answer to the enigma was soon forthcoming; for, if the figures be examined, it will be seen that the middle ones are the greatest; they had travelled the farthest. Hence was demonstrated by this arduously carried out experiment the fact, since more accurately established, that *the centre of a glacier*, like the middle of a river, moves more rapidly than the sides.

With the aid of trained engineers—using a delicate instrument called a theodolite—the investigations were followed up in subsequent years; the icy surface was 'triangulated,' and a noble atlas of the glacier published

APPENDIX I

by Agassiz in his "*Système Glaciaire*." In the same year similar tests and investigations were carried out upon the *Mer de Glace* (sea of ice) near Chamonix, and under the shadow of the dominating *Mont Blanc*. Professor Forbes confirmed the discovery, and with the instruments of precision then at command proved that it was not necessary to wait a year, or even a week, to determine the motion of a glacier; indeed, with a correctly-adjusted theodolite, he

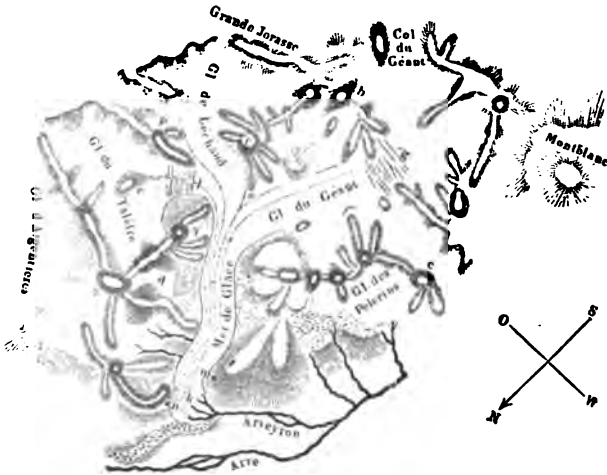


FIG. 3.—Map of the Glacial District of Mont Blanc, showing the *Mer de Glace*.

was able to determine the motion of various points of the ice-sea from day to day. He affirmed, indeed, and with truth, that the motion of the glacier might be determined from hour to hour.

The growth of knowledge is from vagueness to precision, and so we find Professor Tyndall, a decade later, taking measurements across the *Mer de Glace*. By carefully

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marking, by the plummet, the position of the instrument and directing the spider's web cross-lines upon some known and immovable object at the other side of the valley, it was easy to take daily observations. Tyndall, at first, made use of ten stakes; two of them fell, and here is the result of the movement of the eight remaining:

	EAST SIDE.					WEST SIDE.		
Stake No.	1	2	8	4	5	7	9	10
Inches it had moved. }	12	17	28	26	25	26	27	38

Now, in looking at these figures, we see a curious thing, viz., that the posts at the two ends—i.e., those nearest the two sides of the glacier—have not travelled the same distance, and this, we observe, is the same in Agassiz's experiments. But the discrepancy in Tyndall's results is far greater, for, whereas the first post only advanced one foot, the last moved nearly a yard in a day of twenty-four hours.

The observation of the motion of a body so rigid as solid ice apparently is, is strangely interesting. For we see that not only does the ice move *en masse*, but one part of it actually moves past another. All this is so interesting that it is surely worth while to pursue it a little farther, especially as our readers may justly say that the movement of the last referred to row of stakes by no means bears out the statement already made that a glacier, like a river, moves much more swiftly at its centre than at its sides. The stakes near the centre of the glacier in the experiments of Agassiz moved much farther than those at the side; whereas in Tyndall's, whilst the first advanced a foot, the last travelled nearly a yard. Tyndall saw in this fact much for reflection, and much worthy of further labour. It should be explained that the tenth stake was not so close to the remote side of the glacier as was the first to

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the nearer side. Before entering upon a more elaborate experiment, Tyndall attempted to rectify this by extending his line. It so often happens in scientific investigation that, in attempting to accomplish one thing or to verify that thing, one may discover another. In this case the instrument was so placed that it was thought it could command the whole width of the glacier, but Tyndall was surprised to find himself unable to see stakes on the farther side, and, by reason of this *contretemps*, made the surprising discovery that the surface of a glacier when viewed transversely is not flat—like that of a river—but is much higher at the centre. It has, indeed, a “crown” or a convexity, much the same as that of an ordinary country road. It might at first be thought that this might come about from the bulging up of the ice at the centre. This, however, is not the cause, and this may as well be explained here. Everybody knows that a large rock or a brick wall, for example, becomes very warm—nay, even hot—from the impact of the solar rays. One also knows that, in walking past such a rock or wall, the heat reverberated from it and impinging upon the cheek is considerable. Now, it is easy to see that this same action taking place in regard to the rocky sides and moraines of *gletschers* must cause the thawing of the ice to take place much more rapidly nearer the sides than in the medial regions. Hence is explained the convexity of glaciers.

To revert to their motion, Tyndall determined to clear up this interesting matter of the relative speed of movement of different parts of the same mass, for, he tells us, it gave him something to think about. But before a natural philosopher can think with comfort he must be perfectly sure of his facts. He, therefore, straightway set to work to stake out another line, using in this case no less than six-

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and-twenty posts. It will facilitate the understanding of these interesting experiments if the diagram of the *Mer de Glace* made use of by him be reproduced here. The first line he set out was from A' towards A, the next and more elaborate one was from B' towards B. The result of this experiment was to show that the speed of motion of the individual members of the row of twenty-six stakes continued to increase the farther the posts were from No. 1. He was, therefore, farther than ever from confirming the results of Agassiz. Pondering carefully over the problem, however, and drawing analogy with the motion of water in rivers, it became clear to him that, if the gorge of the glacier at this point was upon a bend, then the posts ought to have behaved pre-

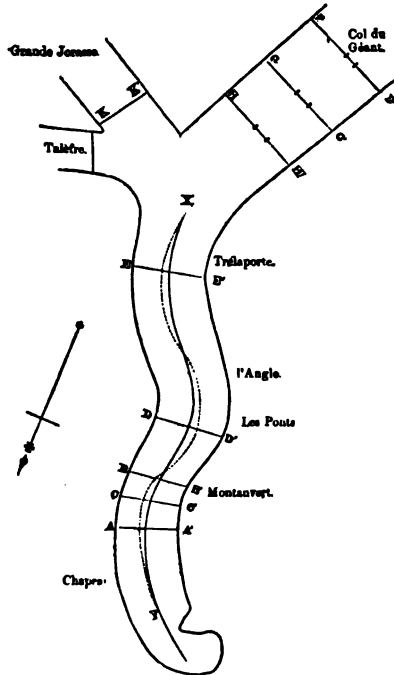


FIG. 4.—Diagram of the *Mer de Glace*, explanatory of the Experiments made by Tyndall.

cisely in the manner in which they had comported themselves. Because, as is well known, the speed of a river is much greater on the side nearer the outer circumference of a curve than upon that "hugging" the nearer bend. Now

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that all this has been done, it is easy for the reader to understand it, for he will see by the diagram that the glacier—at the point opposite to where the philosopher stood upon the *Montanvert*—has a *decided bend*. Consequently it was quite correct that the last post towards B should have moved *more than 2 feet* (26 inches), whilst the second stake, comparatively close to the starting-point B', should have moved forward *less than 1 foot* (11 inches). The reader will also perceive that a post situated close to the side at D would move far less than one driven in near D'.

We all of us know that if we construct an embankment, and thereby reduce the width of a river, the water, in passing that embankment, will have to travel much more quickly than it does in the wider parts of the same river. Every oarsman knows how much harder he has to pull to get his boat through the arches of a bridge than he is called upon to do "out in the open." Is it possible that such a solid-looking and *quasi-rigid* body as ice—which has aptly been called "water rock"—could also behave in a similar manner to the limpid and mobile water of a stream? Tyndall was not content to answer this question except by direct experiment. He, therefore, with immense labour and indomitable perseverance, set out and measured other lines of posts at D, E, H, G, F, and K. By this means he proved, not only that where a glacier is travelling through a straight portion of a valley its centre portion moves much more rapidly than its edges, but also that where the valley is curved the speed is much more rapid on the outer side of the curve. In other words, that the place of greatest motion is determined by the flexures of the valley through which the glacier glides, and that the place of greatest speed shifts from side to side of the valley in accordance with the direction of curvature of the sinuosities.

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The portion of the *Mer de Glace* travelling at the greatest velocity is shown by the dotted line in the diagram.

The question the reader would, we feel sure, desire to have answered is, "How can the solid ice perform in this manner if it be neither flexible nor plastic?" This question we trust we may have answered with sufficient clearness under the head of "Regelation." We know that the ice is not in any way flexible or plastic, for if it were it would not continuously break in a glacier with a report resem-



FIG. 5.—Appearance of the Ice-waves on the *Mer de Glace*.

bling that of firearms, nor would the surface of the vast mass become gashed and cut up by thousands of gaping crevasses, as we have explained is the case.

To an ordinary observer standing upon the mountains these crevasses appear to yawn in any and every direction. How natural and excusable it were thus to view matters the reader will readily appreciate if he will look at the illustration upon this page and also the photograph LXXIII.,

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bearing in mind two things—that the chaotic and turbulent crevassing, apparently so wanting in all order and regularity, is, as it appears to an observer at least, half a mile distant,* and also that such crevasses as can be seen from great distances are really yawning abysses, almost appalling in their magnitude. Some idea of their appearance when near at hand may be gleaned from the photographs LXXV. and LXXVI. The eye of the scientist,



FIG. 6.—Gletscher of the Gorner Grat, showing the Angle of the Lateral Crevasses.

however, sees them quite otherwise; he appreciates, indeed, that they are laid out in directions quite in accord with law and order, and, strange as it may seem to the ordinary reader and to the casual visitor among the moun-

* In taking LXXIII the camera was placed on the opposite side of the *Grindelwald* valley. See "Leg-stretchers upon the Alps" in "Fragments from Continental Journeynings," by the author.

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tains, quite in the manner they must necessarily assume in order to conform to the conditions obtaining.

We will only touch upon one point in connection with the formation of crevasses, because it will probably interest and surprise the reader, for the reason that these crevasses are formed in the direction precisely *opposite* to that in which one would have expected to find them—precisely opposite, moreover, to the direction taken by the ripples on the surface of a river. The reader cannot fail to be im-



FIG. 7.—Mode of formation of Cracks on the Surface of a Glacier.

pressed by this fact if he will carefully look at the illustrations in Figs. 6 and 7, and compare these with Fig. 8. The first is a view of that high-perched ice-field the *Gorner Gletscher* at Zermatt, and there we see the great crevasses pointing their gaping overtures *up* towards the massy and white-clothed *Monte Rosa*. Whereas we all know, if this were a stream of water descending the mountain-side, that the angle of the ripples would be precisely in the opposite direction, and would, indeed, present much the appearance

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shown in Fig. 7, if the stream flowed from right to left. The illustration—from a sketch prepared by Dr. Tyndall—shows the formation of crevasses from a nearer point of view, and there we see very distinctly the curvature they assume. Our first impression would certainly be that such striation, which has the appearance of crack formation in a stream of mud, would be the result of the ice-stream flowing from right to left of the picture, whereas, as a matter of

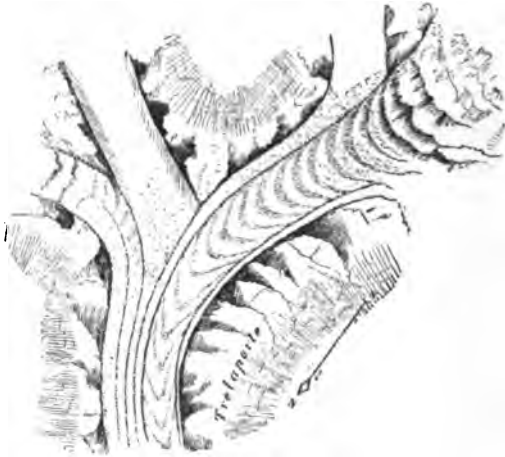


FIG. 8.—Plan of Glaciers, with a Cascade or "Ice-fall," showing the Contour of "Dirt-bands."

fact, the splitting up of the *gletscher* surface as we there see it is due to glacial advance in the direction from left to right. It seems strange at first sight that, although the curves correctly indicate surface movement taking place, and due to the flow of a stream of water or mud or other viscous mass travelling from right to left, they also correctly indicate the manner in which the cracks form in a stream of ice travelling in the *opposite* direction—viz.,

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from left to right—and the reason that the striations shown in Fig. 8 are in the opposite direction is because the dark *laminae* shown are *not crevasses*, but what are known as “dirt-bands,” and these correctly indicate the surface-speed changes taking place upon the ice-river after descending a “cascade.” A photograph of an ice cascade is given in Fig. 11; such an “ice-fall” exists at the point marked *g* on the plan of the district (Fig. 8).

It may be advisable to mention here that there are two principal forms of crevasses, each attributable to a specific cause: the transverse crevasses, which may extend from side to side of the glacier, and the marginal crevasses, which extend only for a greater or lesser distance into the icy body. The latter (see Fig. 6), arrange themselves, as we have explained, in an *oblique* direction (at an angle of about 45 degrees), commencing from the rocky sides constraining the gliding motion of the vast inanimate python, all pointing *upwards* towards the source from which the glacier obtains its ever-being-renewed supplies of *firn* and ice.* “Were you less instructed than you now are,” said Tyndall, “I might lay a wager that the aspect of these fissures would cause you to conclude that the centre of the glacier is left behind by the quicker motion of the sides.” That certainly would be the most ready explanation, although, as we now know, it would be erroneous. This, indeed, was the conclusion arrived at by Agassiz from the appearance of the cracks when

* There is yet another form of crevasse, the *longitudinal*. But this type is formed only when the glaciers debouch upon the valleys, or where—a rather unusual occurrence—a very material widening out of the rock gorge takes place. Crevasses of this class open out, of course, in directions approximately parallel with the longitudinal axis; hence their name.

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the movement of the hut, and subsequently the "hotel," to which we have referred, became known, but before he had measured the motion of the medial regions of the *Unteraar Gletscher*. The correct explanation of the lie and obliquity of the marginal crevasses was, we believe, first demonstrated by the late Mr. William Hopkins, of Cambridge University. We give an explanatory diagram in Fig. 9. This will serve to show the reasoning resorted to. It is quite simple and will be readily understood.

Let one side of the valley be represented by the line VW and the other by $V'W'$, and the stream of ice be flowing

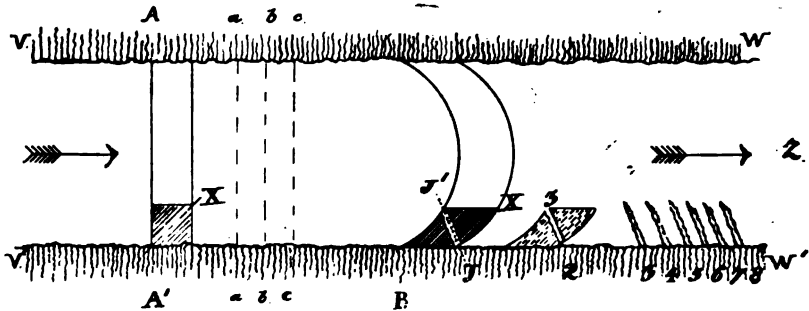


FIG. 9.—Diagram explanatory of the Angle at which Crevasses are formed.

in the direction shown by the arrows. Of this mass of moving ice we will only consider a single section or band $A A'$, and direct our attention to a portion of the ice upon the margin of the glacier enclosed within the square at the side A' . Now we know, from the movement of the stakes, and also from the contour of the dirt-bands, that in a few days the section we are considering, and represented by $A A'$, will have travelled down towards Z , and will, on arrival at the point B , have become bent into a curve, as shown. Now let us see what will have hap-

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pened to our square. Mr. Hopkins has taught us that it will have assumed the distorted or "lozenge-shape," as we see it at B. But we know perfectly well that ice is far too brittle to assume any such shape by bending; thus it is clear it will have been subjected to a very severe strain, and the only question we now have to answer is, "In which direction will the ice snap asunder in order to relieve itself of a strain it is incapable of withstanding?" The diagram answers the question for us. It is only necessary for us to compare the square *before* and *after* distortion to see that one of its diagonals (shown by dotted line A' X) has become greatly lengthened, as we see it at B X. But we know that ice refuses to submit to be thus lengthened, and the inevitable result must therefore be that a fracture must take place across the other diagonal, and hence a crack will manifest itself, and subsequently a crevasse will gape in the direction shown by the dotted diagonal line J J'. It is obvious that, if we considered other slices—as, for example, *a a*, *b b*, *c c*—crevasses due to the forcing forward of these portions of the ice will make their appearance at 2, 3, 4, 5, 6, 7, 8 successively, and that the direction of such crevasses must necessarily be the same as J J' and 2 3'. This, we trust, will make clear the reasons for, and the mode of formation of, the great chasms and billows of ice which confront us, and oftentimes make it so difficult for us to obtain access to the middle of the broad glacial stream.

The transverse crevasses are equally interesting, for their origin is due to a cause as yet unseen by man. Careful thought and speculation, however, led man down to a fall in the unseen bed of the glacial river as the causal circumstance of the formation of the transverse crevasses. The explanation of their appearance seems to have been due to Professor Forbes, who, as we have said, made a survey of

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the *Mer de Glace*, from which the deduction is drawn that its section and inclination is approximately that shown in Fig. 10. The reader will probably be surprised at the gentleness of the inclination or "fall" of glaciers. If the inclination be at all brusque, as we see it at *g*, then occurs what is known as a glacial "cascade." The surface of the ice becomes torn asunder and ripped open into hundreds of transverse fissures and crevasses, and although up to that time its surface may have preserved a superficies like that in LXI., resembling a "pavement of ice" o'erspread with a virgin coverlet of white, unsullied, and unbroken snow, it never again—after its fall at the "cascade,"

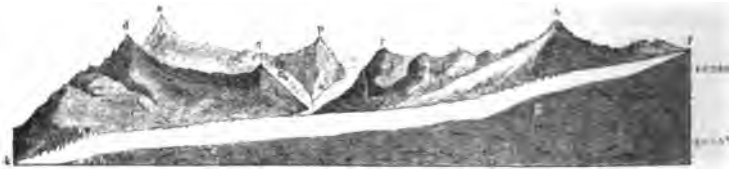


FIG. 10.—Section of a Glacier, showing the Inclination of its Bed. Cascades would take place at the steeper portions at *h* and *g*.

although it may become regelated in the manner we explain, into one unbroken mass—regains its pristine smoothness and tranquillity, for its surface ever retains the acutely indented, mountain-like appearance as we see it in illustration LXXIII. An excellent photograph of an "ice cascade" is Fig. 11, as also that reproduced in LXXXVI. In the latter we see the smooth and alabaster-like surface of LXXXV. by its descent over a steeper portion of the glacial bed (see *g*, *c*, and *h*, Fig. 10) becoming split up into lengthy cracks transversely across its surface. These fissures, at first narrow, we see gradually widening out into yawning crevasses, heeling and toppling over, and finally—ever and anon with

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sound and roar like thunder—falling into a vast heaped-up expanse of icy architecture. But this colossal fragmentation, this Antæan disintegration, is soon repaired by the process to which reference is hereinafter made. A re cementation of the fallen ice-walls takes place, and ever after the glacial stream flows on in acute, wave-like asperity (as we see it in Fig. LXXVII.), or again, welling forward in huge ice - billows, as we see it so faithfully depicted in Fig. LXXVI.



FIG. 11.—An "Ice-fall" or "Cascade."

THE SCULPTURAL WORK OF GLACIERS.

Having now, we trust, dealt at sufficient length with the phenomena of glacial motion and the consequent formation of crevasses, we may aptly conclude by a reference to the work done by these, so potently working, of Dame Nature's

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masons in their sculpturing of our earth, and the beneficent effects attributable to such sculpturing. On first reaching the brink of such glacial streams, one cannot repress an exclamation of surprise at once rising to the lips anent the enormous destructive work there being carried on—an exclamation escaping us before we have time to reflect that no such thing as destruction can ever take place in the workshop of Nature. From this lithic expanse—so chill



FIG. 12.—Moraines upon the Surface of a Glacier.

and so naked, so harsh and asperous—where we see stones, boulders, colossal monoliths, mountains of rock, as it were, all cast down and lying in disorder round our feet, we turn our eyes towards the lowlands, and there we see everything beautifully clothed, everything endued with softness and warmth and colouring. We know that that verdant sward spreading away, mile after mile, is a soft and supple

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coverlet to an equally pliant and sequacious blanketing o'erlying the terrestrial bed—velvet, as it were, stretched upon soft cushions beneficently spread out for the comfort—nay, existence—of man.

Yet it takes a little reflection to bring it home to one's mind that these vast monoliths and boulders—hard to the touch as they are ungainly to the eye, rigid and defiant—are actually in process of transformation, so that they in fulness of time shall form the soft pillowing which shall support the downy coverlet on which it shall be our privilege to walk when we shall have descended from these frigid altitudes. Stranger still it is to reflect that that apparently motionless mass of snow and ice, spread out so quiescent around our feet, shall perform the duty of pulverizing these great strength-embued offspring of the mountain mothers—many as large, it has been truly said by Helmholtz and others, as “two-storey houses”—into impalpable powder, which, kept moist by rain and evening dews, man shall cause to bring forth “the fruits of the soil”—soil into which this stony desert shall at the right epoch be resurrected and become reconstituted.

We may learn the mode of this beneficent transmutation by intelligently questioning those great broad, sinuous, and lengthy bands we see in almost all our photographs stretching their long bodies sometimes only on the margins, sometimes in such fascinating demarcation down the centre, as we see them, for example, in the photograph (Fig. 12); sometimes in multiple and parallel bands, as we see elsewhere, yet always forming such mighty burthens upon the glacial leviathan so clearly brought home to us by Helmholtz's sketch (Fig. 13). These are called moraines, and during the transportation of these burthens takes place that wondrous change to which we have adverted. Looking

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either at the photographs or standing high up upon the Alps, one is compelled to desire a reply to such questions as, 'Why should these Titanic causeways be arranged as we see them?'

We have described, in the words of Tyndall (see p. 325), how the margins become laden with the rocky detritus of the immuring mountains, rocky disintegration the result of hydraulic force at the moment of congelation, as we elsewhere explain. The million-ton body of the ice-trunk itself, moreover, in descending crushes and splinters off,



FIG. 13.—A Medial Moraine, showing the Rock Fragments of immense size borne down.

rasps and abrades, immense quantities of the mountain-side. But, as we have mentioned, the glacial surface, especially in its lower reaches, is overspread with wide crevasses. Down into these the lithic cascade rushes, the bounding boulders drop; down to the nethermost depths of these ice-graves in waiting do they plunge.

But what is their fate? Eternal rest! It cannot be that, for now we know their mausoleum to be moving. These rock fragments are gradually pushed with the encasing ice along the gorge, and at the same time are pressed against its base by the enormous weight of superincumbent ice. "Both the stones embedded in the ice, as well as the rocky base, are equally hard," says Helmholtz, "but by their friction against each other they are ground to powder with a power compared to which any human exertion of force is infinitely small.

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The effect of this irresistible pressure, friction, and attrition is that in due course such rocks become powder—impalpable powder, swept away, as it is produced, by the rushing waters of liquefaction.

Let us, however, watch their movements whilst they still remain visible to us upon the surface, and ask why they should so colligate to form these imposing striations instead of remaining haphazard on all parts of the glacial area. Why, for example, do we see them in Figs. 12 and 13 occupying a medial position? The existence of the medial moraine is the simplest to explain, and its formation will be at once understood by means of the sketch (Fig. 14). Let us assume the confluence of two broad glacial streams of about equal size, and having a similar inclination or "fall." In each case

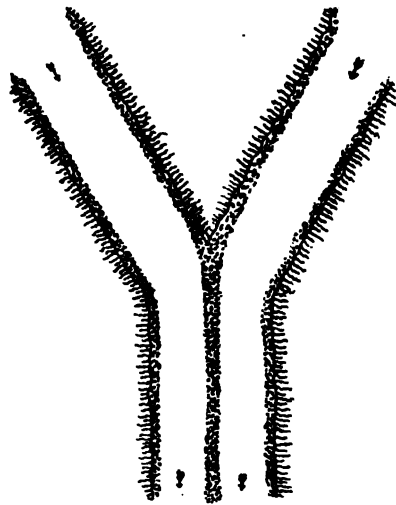


FIG. 14.—Diagram showing the Mode of Formation of a Medial Moraine.

their margins will be heaped up with rock fragments, so that each, *up to the point of confluence*, will have its own pair of *marginal moraines*. What will happen at and below the point of confluence? It is easy to see that the parts of the respective glaciers first to coalesce and commingle will be their adjacent edges, each carrying its lateral moraine, and that subsequent to such coalescence there will be *three* moraines, one of which will

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take its course down the middle of the gletscher, and thus form its *medial* moraine.

It need hardly be mentioned that the number of medial moraines is only limited by the number of confluent glaciers. If a glacier have but two branches, it will only have one medial moraine; if it have three branches, it will have two medial moraines, therefore the number of medial moraines is always *one less* than the number of branches. When a glacier diminishes in size—for successive shrinkings have occurred at intervals of centuries—its lateral moraines are left stranded on the flanks of the valleys, and the formation of a succession of ancient lateral moraines is the result, imparting to many glacier valleys the characteristic aspect they possess. The *Mer de Glace*, for example, has its old lateral moraines running parallel with its present ones.

We have only to climb among the huge components of the lateral moraines—where we feel ourselves so insignificant—and reflect upon the colossal weight they must aggregate to appreciate the stupendous sculptural effect of glaciers, and there behold it. It might at first be thought that the architectural effect of this masonic work would be confined to the fashioning of the mountain summits. It is, however, quite otherwise, for the labours of these of Dame Nature's masons display themselves the more conspicuously at lower altitudes. Were anything needed to add to the entrancing interest of such inanimate sculpturing it would be found in the fact—almost unique in Nature—that we are able contemporaneously to watch the work of the labourer of to-day, and to examine in its vicinity the result of like labour upon the part of its long defunct ancestors. On the mountain brow we watch the labours of the living gletscher, in the awe-inspiring and sterile gorge we witness the vast

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efforts of the moribund, whilst in the valleys we see the perpetuative results of the demised.

How this is brought to pass is made clear to us by a consideration of the various forms of moraines. Just as there are three principal forms of crevasses, so there are three principal forms of moraines. We have spoken of the medial and the lateral, there remains the *terminal*. The former, it need scarcely be pointed out, are always in motion; the laterals may be in motion or at rest, according



FIG. 15.—The Adamantine Pavement of Spotless Firn.

as glacial aggrandizement or shrinkage may be taking place. But the terminal moraines are always quiescent—these erstwhile mobile masses are our valleys of to-day.

All this transcendental transmutation is laid open to us as we descend from the lifeless summits to the verdure-clad glens. There, far up above the habited world, tower the lithic pinnacles—as we see them in the photograph (Fig. 15), and again in Fig. 16—too acute to retain the virgin mantle,

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which, sliding down, forms about their asperous finials an adamantine pavement of spotless firn. Sculptural work is taking place both above and below this glacial surface. Disintegration by frost, as we explain subsequently, deals effectually and expeditiously with the exposed summits, whilst the ever-increasing thickness of the vast expanse of *névé*—its incomprehensible weight consolidating it into solid ice—causes it to descend, as we see it in the



FIG. 16.—The Birth of the Gletscher.

photograph (Fig. 16). Here it encounters summits less exalted as to altitude, but its irresistible gravitation is unimpedable and invincible. Hence these become grooved and chiselled into new forms, and their fragmented portions are borne slowly earthwards—by moraine transport—in the manner we have described.

Here, near the summits, the demolition is less palpably evident, but we have only to descend with the nascent gletscher to witness it in its full force. For when we have arrived below the zone of "eternal" snow, in a region of

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lithic nakedness, there do we see, so well portrayed in our photograph (Fig. 17), the solid rock gashed, torn, crushed, disintegrated, cast down in huge fragments, and reduced to boulder heaps. Our photograph exemplifies the sculpturing of a gorge, the inanimate engineering of a causeway extending its sinuous length mile after mile, as we see it in another photograph (Fig. 18).



FIG. 17.—The Solid Rock gashed, torn, crushed, and disintegrated.

THE GLETSCHER'S DEATH.

Thus at the summit and on the course of the creeping gletscher we are enabled to inspect its sculptural work, but if we descend into the valleys the knowledge we have gained

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by our communing with Nature at higher altitudes will enable us to detect, and to intelligently examine, the result of past labours of the gletscher—labours performed at an epoch long anterior to our own existence, work done when the glacier, to-day a stupendous mass, was a thousand times its present bulk. We see to-day that the rocks and débris carried down by the glacier are finally deposited as it melts at its lowest extremity, where they form *terminal moraines*.



FIG. 18.—“Its sinuous length extending mile after mile.”

Glaciers, although subject to incessant liquefaction of their lower extremities, are as constantly fed by solid ice from the mountain summits. Hence their extremities may, or may not, recede along the bed of the valley. Hence, moreover, these terminal moraines may be laid down to rest at one or at a number of spots in the valley the ancestral gletschers had previously grooved out. A *quasi-stationary*

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extremity will produce a vast local heaping up, a complete barrage as it were, of the valley.*

It has been ascertained, however, that the recession of the glacial extremity takes place intermittently, as is to be expected when one considers the meteorological idiosyncrasies of years or cycles of years, the result being that a succession of more or less concentric terminal moraines is deposited in the valleys. In front of the Rhone glacier, for

* Observations have been made of the movements of the face of glaciers for a great number of years, and *apparently* the results conform to no law, yet if the idiosyncrasies of the corresponding years—such as the amount of snowfall, rainfall, sunshine, air-temperature at the face of the glacier, etc.—could be carefully weighed in the balance against them, it would doubtless be found that the abnormal movements were not only not erratic, but deducible from the meteorological details.

With regard to the Grindelwald gletscher, observations made by the inhabitants of the valley, and recorded in the so-called "House Chronicle," date back as far as the sixteenth century, and speak of several periods of *advance*, in the years 1600, 1680-1640, 1680, 1715, 1740, 1770, regularly followed by periods of *retrogression*. In 1790 the inhabitants of Grindelwald sought permission from their rulers "to drive back the glacier" (by exorcism?), it having increased to an unusual extent. We read that "in 1768 both glaciers had increased considerably, and that in 1777 they were quite low down in the valley. Owing to their unusual height, it was feared that they would spread still further and destroy further pastures. The severe winters of 1768, 1769, and 1770, the true cause of this phenomenal growth, had probably escaped the memories of the inhabitants; but they seem still to have borne in mind the glacier exorcisms of the beginning of the century and their assumed beneficial effects." So a messenger was despatched to Sarnen to enlist the services of an old monk who had acquired fame as an exorcist, but he would only consent to come on their informing him whether the danger "had so greatly increased through the providence of God or through the power of the devil." Unfortunately, no reliable information could be given him upon this head, and so no further steps could be taken.

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example, there are six or seven moraines, whilst the *Mer de Glace* also exhibits a series of them.

We are now in a position to picture what effect the transportation of the mountains' sides and the deposit of the detritus at their feet must have upon the conformation of the valleys. It is at once obvious that in the case of a gradually receding glacier, its medial moraine will become deposited throughout the length of the medial region of the gorge or valley, whilst the lateral moraines, thus brought to rest, will flank this on either side. Broad causeways will, it is equally clear, separate the two classes of moraines, and these causeways would naturally extend throughout the entire course of the valleys were it not for the phenomena of intermittence to which we have referred. If, on the other hand, the rate of recession of the glacier be not uniform and its nether extremity subject to stationary periods, then it is clear abnormal heaping-up of the transported rock must occur.

Hence, when one has thought upon glacial motion and has lingered in the gorges under the shadow of their cooling terminal faces, one can no longer wander in valleys which have been the theatre of glacial phenomena without the fact being at once impressed upon one. In every such valley, no matter how verdant to-day, in every post-glacial glen, no matter how tree-clad, we at once detect the characteristic longitudinal spits or terraces of gravelly detritus and rounded *débris* flanking their sides, the cross mounds barring their extremities and dividing up their length, oft-times leading to the appearance in their midst of clear and limpid lakes. Thus we learn that the valley terraces of to-day are the lateral moraines of passed-away gletschers, whilst the mounds and barrages, and the sloping lake shores of to-day, are the deposited medial moraines of the glacial

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epoch. To those who have thus pondered, the flanking ridges and barring mounds of heterogeneous and oftentimes far-transported *débris*, to-day bringing forth the fruits of the "soil," are certain evidences—whether we come upon them among the mountains of Wales, the Highlands of Scotland, the fjords of Norway, or along the lower valleys of the Alps—of former ice action, of epoch-marking glacial motion.

We have now traced the glacier's motion from its inception amid the mountain summits throughout its steep



FIG. 19.—The Dying Gletscher.

and tortuous course until, our descent being less deliberate than its own, we find ourselves abreast of its lower extremity, which lies, a deliciously cool and glistening mass, refrigerating the sweet and perfumed air of the valley head. Here we witness its demise. Here during the course of long ages has it built for itself a vast rocky sepulchre. Thus up to the very moment of its death has this Titanic mason carried on the work of Dame Nature. Veritably it may be

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said of it that it dies in harness, for, as our photograph (Fig. 19) recalls to us, its chill corpse lies enshrouded within Titanic chippings, the result of its own masonic handiwork. It may be said, moreover, that its frigid vigour had commenced to fail it from the time it had descended earthwards and felt the enervating influence of our more temperate clime. For during the latter portion of its long life its mighty frame has become emburrowed by myriad runlets and arteries, through which has coursed away its life-blood



FIG. 20.—A Subglacial Tunnel.

in the form of glacial streams. Such streams often attain to large dimensions in the form either of profound abysmal channels, and less frequently in the guise of subglacial tunnellings,* such as we see in our photograph (Fig. 20).

* The accumulation of glacial waters has from time to time led to serious catastrophies such as those we have referred to in the foregoing pages. A more intimate knowledge of the structure and motion of glaciers has recently led to appropriate measures being taken for the prevention of devastating recurrences. The magnitude of the ice work

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In this wise the monster giveth up the ghost. Standing as we do beside its deathbed, a creature so insignificant, as we



FIG. 21.—The Death of the Glacier.

and artificial tunnelling entered upon by the Swiss in this regard is surprising. As an example, it may be mentioned that some twelve years ago a water pocket—as such subglacial sealed caverns are called—in the glacier of "*Tête-Rousse*," a spur of Mont Blanc, burst, devastating several miles of country in the district of St. Gervais-les-Bains, and causing the death of about a hundred persons. As it subsequently became known that the water was again accumulating to a dangerous extent, the driving of a tunnel was commenced, in order to provide means of escape for the glacial waters as they gathered. This tunnel occupied a number of years in the making, and when nearing completion it was found to have been inaccurately planned, so that it would have missed the desired point; thereupon another gallery forty yards in length was begun, and this was completed last year, the final great blasting operations setting the district free for ever from these imprisoned and threatening waters.

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find ourselves depicted in our photograph (Fig. 21), yet are we embued with a feeling of pathos as we view the resolution of the mighty mass—endued, it almost appears, with life—as we stand and contemplate the entrancing metempsychosis of its rigid form into the spirit of the waters, watching, as it were, the ebbing of its life as it, dismembered, floats away upon the bosom of the pure stream to which it has given birth, contemplating—our short life precluding us from lingering to witness it—the closing of the book of glacial life, as one by one the icy leaves* fall



FIG. 22.—The Gletscher's Grave.

over and disappear from the earth it has so skilfully wrought.

We stand now upon the brink of the gletscher's grave, which, dealing with matters as we are almost beneath the shadow of the Great Saint Bernard, must perforce be a terrestrial one. Had space availed us, however, we might have described another form of glacial deathbed, vaster and more desolate. For the glorious glaciers of the Alps

* *Vide* LXXXVI., p. 887.

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are as pigmies* in comparison with those of Polar seas, where, unseen by the eye of man, their demise is eternally taking place. In our photographs of the Alpine gletscher's end† we see the dismemberment taking place, fragment by fragment calmly floating away from the mother body. In the colossal Arctic prototype the same process obtains, but all takes place on Antæan magnitude; there the fragments

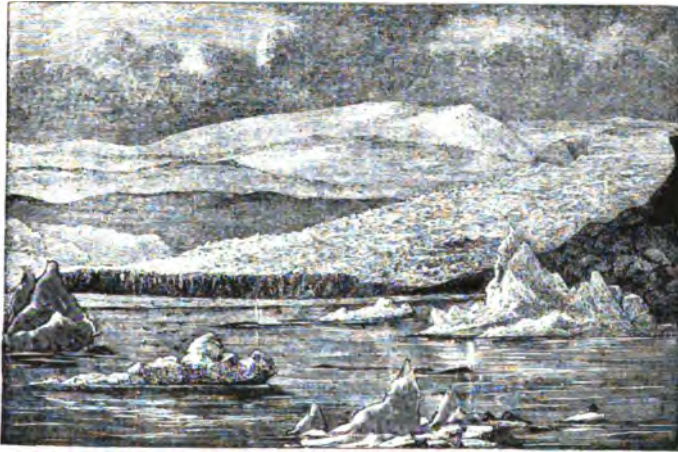


FIG. 23.—The Gletscher's Burial at Sea.

assume the form of icy mountains, icebergs which go floating away to be tossed and dismembered by briny billows. In this connection it may be interesting to point

* The glaciers of Greenland are said to have an average thickness exceeding 1,000 feet, and to move seawards at a speed surpassing 50 feet a day; whilst it has been computed that they discharge into the ocean four square miles of ice 1,000 feet thick every year. The inland ice, or ice-cap, of Greenland is estimated to occupy an area of 20,000 square miles.

† Fig. 21, and also LXXXVIII., p. 842.

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out the extraordinary resemblance between the glacial *serac* and the Arctic *berg*. Usually both take a spirated form



FIG. 24.—A Glacial "Serac," showing the remarkable similarity in form to an Iceberg (Fig. 25).*

similar to that of the *serac* depicted in LXXXVII, but also each is frequently seen in the form of a duplex mass, connected together by an archway or a glacial mass pierced by an aperture. The reason for this interesting similarity will be found referred to in the following appendix.

The foregoing remarks and reflections upon glacial motion will, we trust, have served to indicate the principal changes intervening between the inception and dissolution of Alpine gletschers. Moreover, that they will have indicated the manner in which the beautiful scenery of Switzerland has by their instrumentality been sculptured into form; that by them the beds of the lovely blue lakes of to-day have been dug out, the towering mountains reared aloft, the silent and sweet *vals* shaped out.



FIG. 25.—An Iceberg, showing the remarkable similarity in form to a Glacial Serac (Fig. 24).*

* For explanation, see "Regelation." ..

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We would fain hope that the reader's interest may have been invoked in such wise that his pleasure in wandering amid these mountains may be enhanced by his ability to detect and to localize places of erstwhile glacial activity, to repaint, moreover, into these beauteous spots of a romantic country to-day their appearance under glacial conditions.



FIG. 26.—Moraine Remains in an Alpine Gorge.

Thus concurrently in viewing what he is enabled to identify as glacially eroded *vals* and *thals*—such as are shown in LXVI. and other of our photographs—pictures may display themselves to the mental vision emblematic of the pristine purity of glacial epochs.



A VERDANT VALLEY, ONCE THE ROCKY BED OF A VAST GLACIER.

To face Appendix II.

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CONCERNING THE EARTH

" MYSTERIOUS, in the blaze of day,
Nature pursues her tranquil way ;
The veil she wears, if hand profane
Should seek to raise, it seeks in vain."
(So sings the poet.)

DISAPPEARING LAKES.

THE startling phenomena we have referred to (p. 343)*—the sudden disappearances of lakes—is capable of physical explanation. The principle of action underlying them is that obtaining in what is known as the intermittent syphon. A syphon, as generally understood, is a bent tube or duct, having one of its limbs longer than the other. If such a bent tube be filled with water and the shorter leg immersed in a vessel containing water, the water will not only flow down, and out of, the longer limb, but it will flow up and into the shorter leg ; and this will continue until the level of the water in the vessel has fallen below the mouth of the shorter leg, when, air entering, the flow will instantly cease.

In Fig. 27 is represented the side of a mountain cut

* The footnote on p. 341, referring to a view of the lake upon the *Altsch Gletscher*, should read LXXIV. instead of LXXII.

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through to expose a subterranean cavity in which water has accumulated through the fissures shown. The duct or "crack" in the rock rising from the bottom of the cavern to the apex of its course may be considered as the "shorter leg" of the syphon, the end of the longer leg extending down into the valley. Now it is clear that as soon as the level of

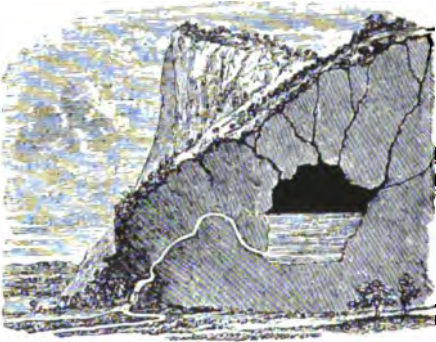


FIG. 27.—An Intermittent River.

the accumulated water in the cavern has risen to the level of the apex of the duct or "crack" (i.e., to the point indicated by the dotted line), the water will rush out—at the bottom of the "longer leg"—into the valley. It is equally clear that it will rush out in far less time than it took

to collect by percolation; hence the cessation of flow will be as sudden as its commencement, and the inundation of the valley consequent upon it. Moreover, one can appreciate that it may be years before a recurrence of the phenomenon—the length of time depending entirely upon how long it may take for the water to reaccumulate in the cavity and rise to overflowing level.*

* It may reasonably be asked, "Why does not the flow cease immediately the surface of the water in the cavern descends below that of the top of the syphon?" This is explained by the fact that for this to occur it would be necessary for the column of water to break in twain at the apex of the syphon, and there to form a partial vacuum. Now the weight of our atmosphere is pressing upon the water at both ends of the column with great pressure (about fifteen pounds to every square

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The principle involved in the phenomena of disappearing lakes may be proved experimentally by means of the simple apparatus shown in Fig. 28. There we have a goblet with a hollow stem, down which passes the "longer leg" of the syphon, the shorter leg being represented by the right-hand half of the circular tube, that from its mouth to the apex of the duct. The percolation by mountain fissures is represented by water flowing from the small tap seen above, and its *modus operandi* is easily understood. The incoming water rises in the goblet until it reaches the apex of the curve, when it flows out from the bottom, but it flows out—the relative diameters of the water-pipe and the syphon-tube being so arranged—much faster than it comes in, hence the goblet is soon emptied. One has then to wait patiently until the water has again collected and risen over the head of the syphon.



FIG. 28.—The Intermittent Syphon.

This will serve to explain the interesting phenomena of "disappearing lakes," but it may be mentioned that it explains also the action of "intermittent springs" found in many countries, and of which an excellent example exists in Yorkshire. The idiosyncrasies of these—as at first sight

inch), the pressure in the cavern tending to force the water out of the duct, the pressure in the valley trying to force it back inwards. These forces exactly balance each other, but it will be noticed that the weight of water in the longer leg is greater than that in the shorter portion, and hence the flow continues; for as soon as there is a break or tendency for the column to break at the syphon head, more water is forced up from the cavity to fill the vacuum, which the ancient philosophers said "Nature abhorred."

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might be thought—erratic springs are most varied. Many of them furnish water for several days or even months, and then, after ceasing for a greater length of time, suddenly recommence. In others the flow commences, stops, and recommences several times in an hour.

CAVES AND CAVERNS.

The sculpturing of the earth into form has been accomplished, as we have pointed out, in various ways, but all of them may be comprised under two heads—the dynamic or kinetic mode, and the chemical. Under the first head are such dynamic processes as volcanic action; such kinetic ones as glacial gravings, hydraulic erosion, and aerial attrition. Perhaps of equally gigantic potency, nevertheless, has been the work of chemical action.

In the foregoing pages we have endeavoured to give an idea of its sculptural effect upon the earth's surface by instancing the enormous weight of the mundane crust borne off by rivers. All this, so to speak, taking place in the light of day, is readily intelligible, but usually we do not realize in anything approaching its true significance the magnitude of the more obscure operation of subterranean chemical action—the dissolution taking place in the bowels of the earth—and the raising to the surface by natural means of the billions of tons of minerals and *solid rock in solution* by means of springs. We speak of “the bowels of the earth”! Yet we must remember that the subterranean depths up to the present explored by us, which, moreover, in all probability will ever be explored by us, is but an infinitesimal penetration inwards towards what we picture in making use of this expression. Indeed, our investigations in this relation might well be likened to the superficial

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examination of the thin covering of wall-paper upon the massive masonry of an edifice. Farther than that we have not yet penetrated; yet what wonders have already been revealed to us!

Perhaps the simplest way to bring home to our minds the mode of action of these miners of Nature is to consider the case of their operations upon an easily soluble mineral—such, for example, as common salt (chloride of sodium). Here is a case in which we can watch a degree of sculptural effect due to our own puny efforts. To obtain this commodity we artificially inject — by means of bore tubes — water into “the bowels of the earth,” and pump it up again a saline fluid, known as brine. By this process — precisely analogous to that taking place in Nature — we every year remove from beneath the surface of the counties of Cheshire, Yorks, and Worcestershire



FIG. 29.—The Chapel of St. Antoine, sculptured in salt beneath the Carpathian Mountains.

no less than four million tons of rock (rock-salt). These operations taking place at what to us appears a great depth, yet are evidenced by their effect upon the surface. For we see huge sinkages taking place, houses subsiding, churches toppling, and miniature valleys formed. Nature, we know, in her operations of mining by solution, by

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such subsidences produces lakes—as, for example, the wonderful *Lago dell' Inferno*, a rocky basin upon the mountains holding a lake half a mile in length, but of unknown depth. A characteristic of such subsidentally produced lakes is that they are furnished with neither inlet nor outlet—are neither fed nor relieved by a river.

But do we pause to reflect upon the enormous cavernous spaces and interstitial honeycombing thus produced; do we, moreover, attempt to compare its pigmy magnitude with the vast operations of Nature's hydraulic mining? If we mentally substitute for the rock-salt thus expeditiously dissolved that apparently unyielding rock known as limestone, which Nature in fulness of time and in like manner dissolves, then we can appreciate the formation in course of long years of such vast caverns as the mammoth cave of Kentucky; a natural piece of subterranean architecture, its principal aisle no less than ten miles in length, and its transepts and numerous ramifying passages aggregating to a length exceeding 200 miles. This interesting example is known to us, but it is logical to assume that myriads of similar below-ground edifices have in like manner been excavated by Nature, though their existence remains as yet unrevealed to us. Happily many, of exceeding interest and of colossal proportions, are known to us, and to these we usually ascribe the fascinating title "grotto." At Antiparos is such a one, where, 600 feet below the earth's surface, we find a spacious hall canopied by a vast dome no less than 240 feet in height. Nature, indeed, carries on her subterranean honeycombing upon a scale dwarfing into insignificance our artificial imitation, to which reference has been made. Her rushing waters—welling through passages varying from inappreciable chinks to spacious tunnels—every year dissolve and disembowel volumes of subterranean

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rocks, which, if deposited upon the surface, would produce veritable hills and mountains. One of the most remarkable instances of such sculpturing is the scenery of the Karst of Carniola, in the Julian Alps. Here a table-land of limestone has become so full of cavities as to resemble a sponge. All rain falling upon it at once disappears and becomes swallowed up in underground channellings, where it rushes among the rocks with a roar audible from the surface, though it courses hundreds of feet below us.



FIG. 30.—The Blue Cave in the Isle of Capri.

Passing through lengthy tunnels, the gathered waters rush onwards in great subterranean rivers, some gushing out at the edge of the table-land—as does the Tiamo—others passing on beyond the land, and finding an outlet in the depths of the sea. The famous grotto of Adelsburg, near Trieste, contains a series of caverns through which an underground river rushes.

Nature, however, is not always wild of aspect in her underground demesnes, for she oftentimes presents to us edifices of calm and tranquillity—nay, of solemn, soundless

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solitude; lovely palaces oftentimes bejewelled with iridescent gems, and sometimes suffused with the effulgence of beauteous azure light words are quite powerless to describe. The thought of the beautiful cave in the Isle of Capri recalls to the mind the ravishing effect.

STALACTITES AND STALAGMITES.

The beautiful pendent, alabaster-like cusps and finials with which subterranean caverns are sometimes embellished, as also their floors with quaint uprearing, many-hued excrescences, have given rise to much speculation as to their mode of formation, but this appears usually to be very imperfectly understood.

Stalactites are more usually found in the caverns of limestone formations, and their presence is primarily due to the existence of carbonic acid gas in rain-water,* causing it to act to a small degree as a solvent of the stone. The action taking place is this: By numerous observations it has been proved that all rocks within the accessible portion of the earth's crust contain interstitial water, or, as it is sometimes called, "quarry-water" (*eau de carrière*). This is not chemically combined with their mineral constituents, nor hermetically sealed up in vesicles, but is merely retained in their pores. It has also been ascertained and established that there is probably no terrestrial substance known which, under proper conditions, is not to some extent soluble in water. By an interesting series of experiments made many years ago,† it was ascertained that

* Numerous analyses of rain-water show that it contains in solution about 25 c.c. of gases per litre. The proportion of carbonic acid was found by Peligot to be 2·4.

† Rogers' "American Journal of Science."

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ordinary mineral constituents of rocks could be dissolved to an appreciable extent even by distilled water. But the presence of carbonic acid gas accelerates and augments the dissolution.*

The interstitial water of igneous rocks may be either an original constituent, deriving its origin, like any of the component minerals, from molten reservoirs within the



FIG. 31.—Stalactites and Stalagmites.

earth's crust, or may have descended from the surface. Of these we have only to concern ourselves with the second.

* We have mentioned (p. 212) the enormous volume of rock which in dissolved form is carried by rivers. The solution, of course, takes place upon the mountains and the surface of the earth generally, and bearing upon this the following experiment and calculation—due to Pfaff—is very interesting. He found that a slab of Solenhofen limestone 2,520 square mm. in superficies lost in two years by the solvent action of rain 0.180 gr. in weight, in three years 0.548, the original

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Rain-water undoubtedly percolates both by minute fissures, or, in process of time, by means of the pores of the rock down to great depths, and hence we find the ceilings of the caverns exceedingly damp. As the water exudes from the pores it aggregates into drops, and these drops will collect for the most part on any slight excrescence which presents itself.

Such slight excrescence, we shall see, forms the nucleus of the beautiful stalactite. For it is clear that whilst the drop adheres to the ceiling, it must be all the time subject to evaporation; it is continually drying up, especially if there be any draught of air, and were it not replenished by further exudation from the rock, it would dry up entirely. But we must remember that the water has been so long in the pores of the stone that it has dissolved, and appropriated to itself all it could hold of the lithic body. Now if a portion of the water be evaporated, and the drop thereby become smaller, it is very clear it cannot continue to hold the same amount of stone in solution as when it was larger. Hence it is compelled to deposit some of the rock it had dissolved upon the ceiling. This, of course, slightly increases the size of the excrescence upon which the drop originally formed, and this marks the epoch of inception of the stalactite, the growth of which—to the maturity in which we see it—may require hundreds or thousands of years.

The stalactites in maturity are hard and solid, and often emit a musical “ring” when struck with a pencil or light cane, but their mode of formation causes them to present a

polish being replaced by a dull earthy surface, on which fine cracks and incipient exfoliation manifested themselves. Taking the specific gravity of the stone at 2.6, the yearly loss of surface amounts to $\frac{1}{72.8}$ mm., so that a mountain crest or crag of such limestone would be lowered more than a yard (1 metre) in 72,000 years by the solvent action of rain. We have elsewhere (pp. 205 *et seq.*) spoken of rain laving.

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most interesting cross-section, both in regard to form and colour. For as each drop gathers upon the roof and begins to evaporate and lose carbonic acid, the excess of carbonate of lime it can no longer retain is deposited round its edges in the form of a ring. Continuance of exudation—drop succeeding drop—lengthens the original ring into a long pendant tube which, by subsequent deposit inside, becomes a solid stalk. At first the calcareous substance is soft, and when dry pulverulent, but it becomes by degrees crystalline. A strange feature, however, is that each stalactite is found to possess an internal radiating *fibrous* structure,* the fibres passing across the concentric zones of growth. The mass of the stalactite remains saturated with the calcareous water, and the divergent prisms are developed and continued as radii from the centre of the stalk. The section of the stalactite is, as might be expected, composed of concentric rings, and these vary in colour, due doubtless to the oxidation of the metallic constituents originally dissolved in the water, deposited upon the surface of the thus growing mass, and acted upon by the oxygen of the air. How long it requires to form a

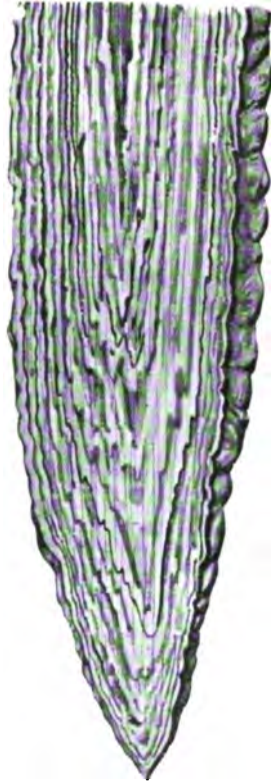


FIG. 32.—Longitudinal Section of a Stalactite. (Highly magnified.)

* See Fig. 38.

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stalactite of given length and diameter it would be difficult to say, but Sir Archibald Geikie mentions that in 1874 stalactites were taken from the North Bridge, Edinburgh, which was erected in 1772, and that these measured one inch and a half in diameter. These also possessed the characteristic radiating structure we have referred to.

Stalagmites.—The shape of the stalactite is usually acutely pointed, as we see them, Figs. 31 and 34, and also in the illustration XLVIII., a conformation it is easy to understand

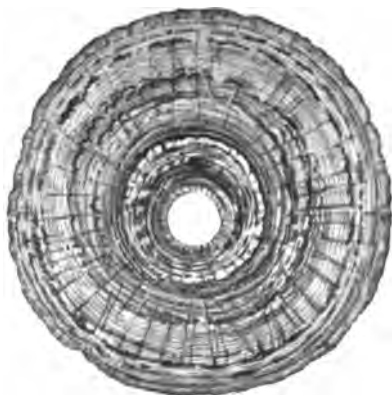


FIG. 33.—Transverse Section of a Stalactite.
(Highly magnified.)

when one reflects that the water gradually coursing down its sides is uniformly diminishing in volume, which is the case with a pointed body. The water may or may not accumulate in a drop pendant at the point of the stalactite, according to the speed with which the base of the cone is fed by the exudation from the ceiling of the cavern. If, on the other

hand, it be fed to the stalactite more quickly than the air can evaporate it and the drop falls to the floor, another interesting phenomenon is given rise to. For obviously, on the drop falling to the floor the evaporation will continue, and thus another nucleus will be formed, and the process we have already described will be continued, with the difference that the growth of the formation will be upwards instead of downwards. These growths, rising from the floor to meet the down-growing stalactites, are called stalagmites, and are

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often most interestingly grotesque in their form, as we have mentioned elsewhere,* and also at p. 218. In their earlier stages they are of course discs, more or less circular, with which the floor of the cavern becomes tessellated. These discs and incipient cones of the stalagmites usually present much variety in colouring, so as to give the appearance of



FIG. 34. —Junction of Stalactites and Stalagmites, forming continuous columns.

a carpeting to the floor of the cave. Due to the unevenness of the floor, these growths frequently assume the most grotesque shapes, which the guides in such caverns exert their ingenuity in likening to various objects. When, however, in the course of ages, they have reared themselves up

* "Fragments from Continental Journeyings."

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some height above the bottom of the cave, they take the form of pointed columns, oftentimes of alabaster purity, as we see them in Fig. 31. Each stalagmite must obviously have its own stalactite pendant immediately above it, seeing that it is itself formed by evaporation of surplus water falling from its superpendant companion. Hence it must happen that if each pair continue to grow long enough they will eventually join at their extremities; but, the water continuing to trickle down the duplex stem, this in fulness of time will become thickened into a beautiful column extending from floor to roof of the cavern.

Hence is explained the phenomenon of the formation and embellishment of these interesting subterranean edifices, replete with their variegated pavements, their graceful columns, their vaulted ceilings, and their pendent valances. There remains to be mentioned yet another feature, for the architecture is oftentimes supplemented by what appears to be drapery of the walls. This arises from the fact that in many places the walls, like the ceilings, are bathed with moisture; and the evaporation of this water, setting free the stone dissolved within it, causes the walls to become swathed with stalagmitic excrescences closely approximating in appearance to drapery. Perhaps the most perfect example of this within our knowledge is "the curtain stalagmite," to be found in one of the beautiful stalactite caverns at Cheddar, in Somersetshire, of which we present a photograph on the opposite page. The forms taken by the stalagmites forming upon the walls are of infinite variety.

The south-eastern districts of Belgium are very rich in stalactite grottos of immense size. And so diverse are the wall configurations that the different and numerous saloons, as they are called, are named after the objects it is considered they may represent. In our photograph (Fig. 36)

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we show the portion of the *Grotte de Han-sur-Lesse* known as the "cascade." The forms assumed by the stalagmites are most interesting, and in this instance, it will be observed, simulate the appearance of a cascade of water, whilst the magnitude of these interesting formations may be judged



FIG. 35.—The "Curtain" Stalagmite in the Cave at Cheddar.

from the fact, as will be seen, that a number of persons can find room between the wall of the cavern and the back of the cascade.

Visitors to the caverns in Yorkshire and Somersetshire will

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doubtless notice that the rows of stalactites and their corresponding stalagmites are laid out with a certain degree of regu-



FIG. 36.—The "Cascade" Stalagmites in the Grotte de Han-sur-Lesse, Belgium.

larity, so that in some cases a succession of columns, formed by their junction, is made to represent a kind of tracery screen. This is to be explained by the fact that the formation of stalactites is largely limited to what are known geologically as the joint-planes of the rock; thus the pendants born of them are usually found to be arranged in rectilinear series, and frequently at right angles to one another. Hence, as the direction of the cavern is more or less determined by the same joints, one set of stalactites will be observed to be parallel

with the length of the cavern, whilst other sets will be ranged across it.

PETRIFICATION.

THE phenomenon of petrification is closely allied to stalactitic formation, the principal difference being that, whereas in the stalactite and the stalagmite the evaporation of the siliceous water causes a solid to form upon a nucleus of the same material, in petrification permeation of the water into

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the pores of an existent material brings about such a lithic change that, for all intents and purposes, the material becomes stone. Petrifying wells are to be found in various parts of our own country—as, for example, at Knaresborough. In these, articles of the most flexible nature, such as a piece of cloth, a straw hat, a soft felt one, and such-like, by prolonged immersion become to all appearance stone. Perhaps, however, the most interesting example of the effect of submergence of material beneath water highly charged with dissolved stone that could be cited is the “Petrified Forest” of Chalcedony Park, U.S.A. This most interesting natural phenomenon arose from the inundation of a district with the water—erstwhile boiling—from a volcano in eruption. The reader need scarcely be reminded that hot water is capable of holding in solution a much larger quantity of material than cold water. For example, a boiling solution of sugar will remain perfectly clear whilst hot, but upon cooling it will find itself incapable of sustaining invisibly so large a quantity of sugar, and this, as we know, will become solidified in the form of beautiful crystals. Hence the conditions requisite for petrifying the forest were amply complied with, and the result in consequence has been most extraordinary.

In describing stalactites and stalagmites, it was pointed out that these were built up of concentric rings widely differing in their colour. At first sight this seems most extraordinary, but when we reflect that the water percolating down to the ceiling of the cave must of necessity pass over the earths, or “salts,” of different metals, and when we further reflect that, even in infinitesimal trace, metal—upon oxidation—will give rise to brilliant colours, we at once appreciate that such multi-colouring must ensue, and we see clearly also that it must take place in the form of annuli.

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A trace of iron, for example, will redden a mass of stone; again, a trace of manganese may produce either pink, mauve, or black. One is, therefore, prepared to learn that the colours of this petrified forest are most beautiful. The trees lie prone upon the ground, and everything to-day is stone—stone of an exceedingly durable quality, the predominating colours being a sombre red, a rich brown, and black. Every tree, every shrub, every stone is iridescent. Everything is encased in a deposit of resplendent crystal, an embalmment surpassingly beautiful. Such crystal deposit,



FIG. 37.—Coloured “Terraces” formed by the Deposition of Dissolved Rock from Boiling Water.

it is easy to see, is precisely analogous in its composition to precious stones, the colouring of all of which is, of course, due to metal.

The district is exceedingly difficult of access, but it has been most carefully explored by Mr. C. H. Hovey, who tells us that although “there are neither rubies, sapphires, nor diamonds, yet there are amethysts, jaspers (red and yellow), topazes, onyx, and agates of every imaginable variety.” One might refer to this curious and *quasi*-accidental effect,

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in other words, by likening it to a forest of quartz. Quartz in nature is usually a white translucent and crystallized solid, but in this petrified forest, for the reasons given, the incrustations are of the richest colouring, the reds, the browns, the yellows, and the purples—all attributable to the two metals referred to—combining to form a gorgeous scene, the whole of the interesting phenomenon being due to the deposition of calcareous and siliceous matter previously dissolved in water, and yielded up upon its evaporation in a manner precisely analogous to the formation of stalactites and stalagmites.

In various parts of the world, by action precisely analogous to that just described, abnormal and most beautiful objects and aberration of scenery have been produced from the deposition of rock previously held in solution by boiling water. Of such might be mentioned the beautiful lithic basins formed by the overflowing waters of "petrifying" boiling geysers. One of the most lovely of such effects was to be seen in the "pink terraces" of New Zealand, an almost unique natural phenomenon, unhappily recently damaged by earthquake.

THE APPARENT PLASTICITY OF ICE— REGELATION.

The fact that ice, after descending a sinuous path in glacial motion—bending, as it were, from this side to that and often turning sharp corners—may yet be found to be one solid mass, unfractured, and perfectly homogeneous, at first sight would lead us to attribute to it the property of viscosity or *plasticity*. Yet, as a matter of fact, ice is in no appreciable degree viscous or plastic any more than water is compressible. To explain the ability of ice to

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change its form, we have to consider the extraordinary property it possesses of reuniting its broken fragments into a new, homogeneous, and translucent mass—a property to which Dr. Hooker applied the term *regelation*. Michael Faraday was the first to observe this wonderful property of ice, for in 1850 he called attention to the fact that pieces of moist ice placed in contact with one another will freeze together even in a warm atmosphere. It is due to this fact that the metamorphosis to which we have referred, wherein the light and flocculent covering of snow, composed of the airy, flower-like crystals illustrated in Plate V., becomes transformed into solid, glass-like ice, is enabled to take place. Into the scientific nature of the process involved we must not here enter, for it is somewhat recondite, and has given rise to much speculation and philosophical controversy. It was thought at first that it might be due to pressure; but Faraday, with his characteristic custom of questioning and answering nature and brilliant experimental ability, showed that regelation takes place equally well *in vacuo*.* Moreover, fragments of ice floating on water are found to unite themselves into a solid mass, beautifully exemplified on the gigantic scale in the agglomeration of the ice floating in the polar seas into vast ice-fields.†

Whatever may be the true scientific cause of this phenomenon, it suffices for us here to point out that this fully explains the ability of ice to change its shape, as it is continually doing during glacial movement. It is indeed fractured, cracked, and crevassed time after time, yet the

* Even in a vacuum it was contended by some that pressure due to capillarity was the cause.

† Regelation, it may be interesting to mention, takes place between particles of ice floating in warm water even when the water is too hot to bear the hand in.

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gaping crevasses become closed, pressed together, and, *regelation* setting in, reunited into a homogeneous whole, as we find it around us when we penetrate into the beautiful caverns cut in its mass. If whilst therein we press a flat piece of ice against the wet sides or ceiling, we shall find it will become united to the glacier, and in doing so we shall have performed an experiment in regelation. Due to this property, Professor Tyndall succeeded in moulding fragmented ice in box-wood moulds.

A very beautiful experiment, first carried out by Mr. J. T. Bottomley, and illustrated in Fig. 38, may be performed in our own homes. A large block of ice supported at its two ends has placed around it a piece of copper wire; to this wire is hung a heavy weight. The wire gradually makes its way through the block — occupying, perhaps, an hour or



FIG. 38. — Experimental Proof of Regelation.

two in its passage—and at last drops out upon the floor; but careful examination of the ice will show it to be *still a solid block*, the reason being that just as fast as the wire was dragged through it by the weight *regelation* set in, and the surfaces froze together again into one mass.

By means of this interesting experiment the reader will be enabled to understand how the ice of a glacier is enabled

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to perform the contortions necessary as it glides through tortuous and oftentimes brusquely reticulating gorges, without becoming disintegrated and fragmented, as the rocks themselves become. We see that it is possible for the solid ice to become cracked and fissured, and for these fissures to open into gaping crevasses, to be subsequently closed by pressure as the gletscher glides through fresh portions of



FIG. 39.—Ice Flowers.

the gorge, and yet by the interesting property of regelation we now know it to possess, the ice may still retain its solid form and transparent nature. It also teaches us how it comes about that enshrined within solid ice may be found bodies entirely foreign to it. How, for example, stones and even human bodies, as we have mentioned, which have fallen down the open crevasses, may be found centuries later encased in solid ice. It also explains how air comes to be rigidly imprisoned within solid ice, and, indeed, spaces

devoid of air; the latter phenomenon giving rise to the beautiful structure which Tyndall has named "Ice Flowers," an example of which we give in the illustration.

We are also now in a position to explain a circumstance which has given rise to much speculation, namely, why icebergs should so frequently have their huge bodies punctured by great apertures. These have often been

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ascribed to the washing action of the waves. But this explanation is incorrect, seeing that the punctured conformation



FIG. 40.—An Iceberg punctured by a Great Aperture.

tion is to be observed before the ice-block has become detached, and also, as we have seen, the seracs upon inland



FIG. 41.—A Snowberg punctured by an Aperture.

glaciers often present a precisely similar configuration. The answer is to be found in regelation, for we who have

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watched the spinous surface of gletschers know that from time to time the huge and acutely-pointed seracs topple over and rest the one against another. A large space, there-



FIG. 42.—Snow Crystals.

fore, is left between their bases, whilst on the other hand their apices are in contact, and subsequently become regelated into a solid mass—a solid iceberg or serac, as the case may be, punctured with a huge aperture.

One has also to remember, as we have explained in the foregoing pages, that *snow is ice*; but it is ice of a less solid form, being, as we have mentioned, an agglomeration of myriads of the most beautiful ice flowers or crystals (see Fig. 42). But if we think still more deeply about these exquisitely interesting phenomena, we shall appreciate that the binding together of these beautiful flowers is, in itself, the result of regelation, as also is the agglomeration of snow into snowballs. Perhaps the most interesting example one might quote of advantage being taken by man of the regelation of snow is the utilization of this erstwhile light and flocculent material by the Laplanders and the Esquimaux as building material for their dwellings.



FIG. 43.—Snow Houses of the Esquimaux.

SNOW BRIDGES.

The natural formation of bridges of snow across profound crevasses often many feet in width has given rise to much surprise upon the part of mountaineers exploring glaciers,

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the more so when it is found that in many cases these snow bridges are capable of supporting a considerable weight, and that, indeed, one may use them as one would a bridge of stone.

Their formation is difficult to explain. They may be formed by avalanches and snow-drifts suddenly filling up the crevasses to a certain distance down, for it must be remembered that the crevasses are wedge-shaped, and hence any sudden intrusion of snow has the effect of blocking them up for a short distance down. It is more difficult to see how they can be formed by snow gently falling under normal conditions upon the surface of the ice, but we must remember that the widening of crevasses—after the first sudden fracture—is a very gradual process, and this gives the snow bridge the requisite opportunity of slowly building up. The formation of crevasses—viz., by fracture—is so sudden as to be accompanied by sounds as of explosions beneath our feet, for the sudden disturbance of strain and stress of the ice due to one portion giving way almost invariably causes several other fractures to occur in quick succession, and hence one hears a succession of reports. It is difficult to find the incipient crevasses, for they are barely of sufficient width to admit a knife-blade; but their presence may sometimes be indicated by bubbles of air rising through the water of a glacier pool, at the bottom of which, scarcely visible, may be seen the young fissure, and this may be traced for long distances on either side of the pool.

The fissures being enlarged in width in this very gradual manner, it is easy to see how bridges may be formed in the winter when the surface of the glacier is more or less covered with snow. The gradual enlargement of the clefts beneath the coverlet of snow will not have the effect of causing cracks to manifest themselves in the snow covering,

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for any slight attenuation will, of course, be more than made good by subsequent snowfalls. Indeed, if we reflect, we shall see that the gradual widening of a crevasse below a snow-shroud will have the effect in many instances of causing the overlying stratum to assume somewhat the shape of an ordinary mason-built bridge, because by portions falling away from beneath as the cleft widens, the arch at its "crown" will be less in thickness than at its ends, where the nearly vertical sides of the crevasse form its buttresses.

The most surprising feature of snow bridges, however, is that they should be sufficiently strong to allow people to pass over them. From the explanation given in regard to the phenomenon of regelation, however, the reader will now be able to appreciate how this strengthening and solidification is brought about. At first the snow is light, flocculent, and granular; but the water of liquefaction, through numerous partial thawings, fills up the granulation spaces and aerial interstices, and thus by the operation of regelation the snow, especially that beneath the surface, partakes more or less of the nature of solid ice.* From this cause snow bridges become so strong that they can support several mountaineers at the same time, as we see in one of our illustrations (LXVII.); this, indeed, is a veritable viaduct; a shorter and very substantial bridge is illustrated in another photograph (LXVIII.).

* A precisely similar transformation in the nature of snow from a loosely adherent and openly granular mass to a *quasi*-solid is noticeable in the process of making snowballs. The heat of the hands thaws the surface, and much of the water of liquefaction finds its way into the body of the ball, and regelation ensuing makes it far too solid, if continued, to be a suitable projectile for use in a friendly snowballing bout.

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SCULPTURING BY FROST AND WATER.

The fashioning of our world may be said to have been effected by two principal processes very analogous to the building operations of man. For we have first the bodily placing of the materials in position, and subsequently the sculpturing of the surface into form. The first operation of transcendental interest belongs wholly to that fascinating science geology, and lies beyond our present domain. The sculpturing did not commence till long ages subsequent to



FIG. 44.—The Virgin Crust.

the wrinkling up, by internal statical stress and consequent dynamic convulsion, of the pristine sphere. Had not the materials been by this means laid out in readiness for the inanimate masons, it is obvious their operations could never have been productive of such variety of architectural effect as has been the case, for it was due to the forces previously acting that the crust of the earth became built up of material differing widely as to constitution and hardness.

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Had the crust of our earth been a primeval pavement of uniform texture and hardness, then it is clear that the effect referred to of a *uniform* removal of its superficies, whether by solvent action, erosion, or attrition, could alone have taken place, and our world would have remained mountainless.

Directly, however, it is conceded that by the wrinkling of contraction and extrusion by upheaval the pavement forming the orbal superficies came to be composed of



FIG. 45.—The Incipient Fissuring.

material of diverse density and widely varying wearing capabilities, then it is easy to picture that the variety of form into which the succeeding sculptural agents were capable of chiselling it became almost limitless.

To rivet this fixedly in the mind, let us consider that we had prepared two spheres to be subjected to reducing action by the agents employed by Nature—two balls, for example, the one made of sand and stones bound together

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by cement, the other of the same materials agglomerated with soap. Were we to set the two spheres out in the open to "weather," we know precisely what would take place. The effect of rain laving upon the first would be limited to an infinitesimal and almost uniform removal of its surface, the speed at which this would take place being deducible from the experiment we have referred to, made by Professor Pfaff. Turning to the otherwise agglomerated sphere, we



FIG. 46.—The Noble *Aiguilles* of Nature.

know that a very short time would suffice to produce a change in the appearance of the surface, and that such change would be by no means uniform. The more soluble portions would rapidly enter into solution with the rain-water; the lesser soluble portions, however, would be affected only to the sluggish extent of the other sphere, and hence pitting and channelling would speedily occur, and the runlets, carrying away with them the fine grains of sand, would at once commence an erosive action analogous

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to that of Nature. Our second sphere, therefore, would speedily become graven with its hills and valleys, studded with its hillocks and ingles, and traversed by rivers and wealds; whilst the larger and harder stones, remaining practically unattacked, would stand out in striking isolation, just as we see the noble *aiguilles* of Nature so boldly standing forth in our photograph.

In considering the fate of our little artificial worlds, we



FIG. 47.—The “Weathering” out of the Master Joint-planes.

have confined ourselves to the effect of water *per se*; and were the rocks of the earth's crust subjected only to the effect of this, they might almost triumphantly defy its ravages, but their demolition is heralded by the advent of frost. The vulnerability of rocks, however, in this regard is very largely dependent upon the character of the surface exposed. If this be even and free from fissures, then is frost's hand laid upon it in far less destructive manner. When, however, the master joint-planes, by solution and

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erosion, have become fissured out in the manner we see them in the accompanying photograph, then is the death-knell of the noble headland heard.

We have drawn attention to the interesting manner in which mountains become disintegrated and eventually converted into "earth" or "soil." But the enormous power exerted at the moment of *congelation* is probably far from adequately appreciated. To bring this home to the general reader we would refer to a queer and instructive experiment made so long back as 1785, at Quebec, by Major Edward

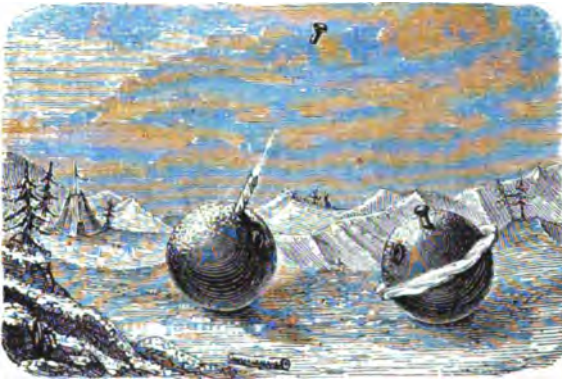


FIG. 48.—Bombs exploded by Freezing Water.

Williams of the Artillery, the effect of which is shown in Fig. 48.

Two large bombs—thirteen inches in diameter—were filled with water, the fuse-holes being firmly closed by iron stoppers. The cannon-balls were then exposed to intense frost, with the result that, upon the freezing of the water, in one case the stopper flew out and was projected some 200 yards, a cylinder of ice—seen in the illustration—eight inches in length, being extruded from the opening;

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whilst the other bomb was rent asunder, and a sheet of ice—also seen—was forced through the crack. With this in our mind's eye, we can easily understand why it is that enormous masses of rock are continually forced off the face of the mountains.

On freezing, water is increased in bulk to the extent of about one-fourteenth of its volume, whilst the energy with which such increase in bulk is effected is vividly brought to our minds by the illustration of the frost-exploded bombs;



FIG. 49.—Rocks cast down by the Action of Frost.

hence we can at once appreciate that, the force being resistless, the masses of rock frost is competent to cast down are almost illimitable in magnitude. An excellent idea of the destructive action of frost upon rock formations is given by the illustration, but to appreciate the colossal effect of demolition by frost one has to clamber among the titanic lithic *débris* at the foot of a mountain chain.

In order that the reader may be able to follow the gradual growth of the process, we have presented photographs typical of the changes taking place. So long as the rock formation remains comparatively free from open fissures, the sculpturing effect is confined to the solvent action and erosive effect of water. Such obtains in regard to the virgin crust, as one might look upon a *quasi*-unfissured portion of a mountain summit, such as we see in Fig. 44. When, however, the incipient fissuring has advanced—as we see it in Fig. 45—to the extent of pro-

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viding "pockets" for the retention of water, then the expansive effect, as typified by the bombs, sets in, and in a short space—geologically speaking—the destruction is so pronounced as to produce by its differential effect upon fissured and lesser fissured formations striking architecture, such as we see in Fig. 46. The fashioning of the crust of the earth into the forms familiar to us, it should be noted, is upon land due to a dual effect, upon the seaboard consequent upon a dual process. A marine headland, such as is



FIG. 50.—"Screes" formed by the Descent of Disintegrated Rock.

depicted in Fig. 47, may indeed suffer change so rapid as to be noticeable in a single generation. Here, the divisional planes having been washed out by rain-laving, frost has unhampered play, and continues the work of destruction by forcing off and casting into the sea huge masses of the solid rock erstwhile intervening between them. But, concurrently with this frost and fresh-water graving, we have the enormously potent carving effect of the ocean. The *débris*

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cast down by the former agents is caught up by the incoming billows and hurled back upon the now honeycombed face, and like the working of a giant hydraulic battering-ram, the undefended wall is ever and anon breached and caverned, whilst continuously the great scouring action of the waves with loud voice tells its tale.

To the thus mercilessly carried on siege operations has, under these circumstances, to be added yet another mining action, one less known and appreciated—the boring action of compressed air, a pneumatic ramming, as it were. As each wave spends its fury against the lofty wall, air is driven into every crack and cranny, and from every interstice rock fragments are detached.

We island-dwellers know full well that ofttimes great caves become burrowed out beneath our cliffs. Sometimes far back upon the cliff-top meadows we find great shafts, like those of a coal-mine; and as we peer down into their depths we hear the rush and roar, the ebb and flow of the attacking waves far from where we stand, doing their work upon the rock-strewn headland. Sometimes the shaft resembles a huge cauldron-like crater, in the depths of which are seen ebbing and flowing the seething waters, the foam into which they are lashed ever and anon discharging like a volcano from the mouth of the cauldron. But the power of the reciprocating wave is transmitted beyond its own range of action, for in its impetuous onslaught it drives the air before it, compressing it with enormous force into every cavity, from which by its own elasticity it immediately becomes expelled with an energy dealing further destruction. So great is this pneumatic action, and so palpable its effect, that to the phenomenon has been given the names of “puffing-holes” and “blow-holes,” and so violent is their action, due to a tempestuous sea, that blocks of rock of

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considerable size have been observed to be blown into the air from their landward *embouchures*. Examination of these "blow-holes" has shown that, leading down into cavernous gullies, they oftentimes connect one cove to another behind bold, rocky headlands exceeding 100 feet in height. Thus we see how the land becomes undermined by the sea, whilst the connection of these interesting pneumatically sculptured passages also teaches us how headlands and promontories gradually become converted into islands.

The cast-down *débris* is sometimes made the tool of the elements in a form of boring and excavation of much interest. We have referred to the "pot-holes" of the glaciers, and one witnesses similar phenomena in the "kettles" of rock formations and the "pot-holes" of rivers and the seashore. These curious circular cauldron-shaped cavities, bored out with very smooth sides, may often be observed along the walls of rocky



FIG. 51.—"Pot-hol s."

ravines. They are formed by the gyratory motion of cast-down fragments, which by the grinding action assume a more or less spherical form; these balls are kept in rapid rotary movement by the rushing waters; by this means these strange cavities are gradually excavated. Pot-holes are often found in rows and on the sides of many narrow gorges. Traces of numerous old pot-holes may be seen high above the present level of the rushing stream. These indicate original levels of the water, and demonstrate how in course of ages the rock bed has been gradually rasped out. In our

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illustration we show pot-holes on a foreshore, wrought out by the eddying rushes of the tide. The ceaseless casting up and withdrawal of the shingle also produces gigantic rasping action, so that it often happens that the lower portions of projecting cliffs become worn away much more rapidly than the above-water portions. This gives rise to the formation of the natural archways sometimes to be met with on rocky coasts. Under this form of water and material erosion the architecture of the shore-line not infrequently presents a weird and interesting grotesqueness, such as that of the rocky arcading we see in the illustration.



FIG. 52.—Grotesque Coast Architecture.

Thus is brought home to us the indisputable fact that from the tops of the mountains down to the margins of the oceans the continents of the world are slowly, but surely, being ground down, and in time must reach sea-level. With regard to the American continent, research and calculation put the speed of wearing down by rain* and rivers at one foot in six

* There are, as we have shown, other potent factors at work, but from the foregoing it might be thought that in arid positions, where rocks are not subjected to the actions of water, the formations would escape destruction. It may therefore be interesting to add that Dr. Livingstone found in Africa (12° south latitude, 84° east longitude) that surfaces of rock which during the day were heated up to 137° Fahr. cooled so rapidly by radiation at night that, unable to bear the strain of contraction, they split and threw off sharp angular fragments from a few ounces to 100 or 200 pounds in weight. In the plateau region of North America, though the climate is too dry to afford much scope for

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thousand years, whilst were no upheaval to take place, the British Isles would be levelled in about five and a half millions of years.



FIG. 53.—The Rounding-over Effect of Water upon Homogeneous Rock.

Turning again to inland sculpturing, we find the dual effect to be due largely to change of contour of the hillsides, by the sliding down of the detritus disintegrated by the operation of frost, this daily vicissitude of temperature produces results that quite rival those usually associated with the work of frost. Cliffs are slowly disintegrated, the surface of arid plains is loosened, and the fine *débris* is blown away by the wind.

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the processes we have explained. Sometimes, for example, characteristic scenery is produced by the formation of "screes" (see Fig. 50), built up of the fallen fragmented material of the mother hills.

Having thus far traced the cause and effect of natural sculpturing, one can at once appreciate that by a glance at the scenery of a countryside the eye of the geological student can at once determine the class of rock which has

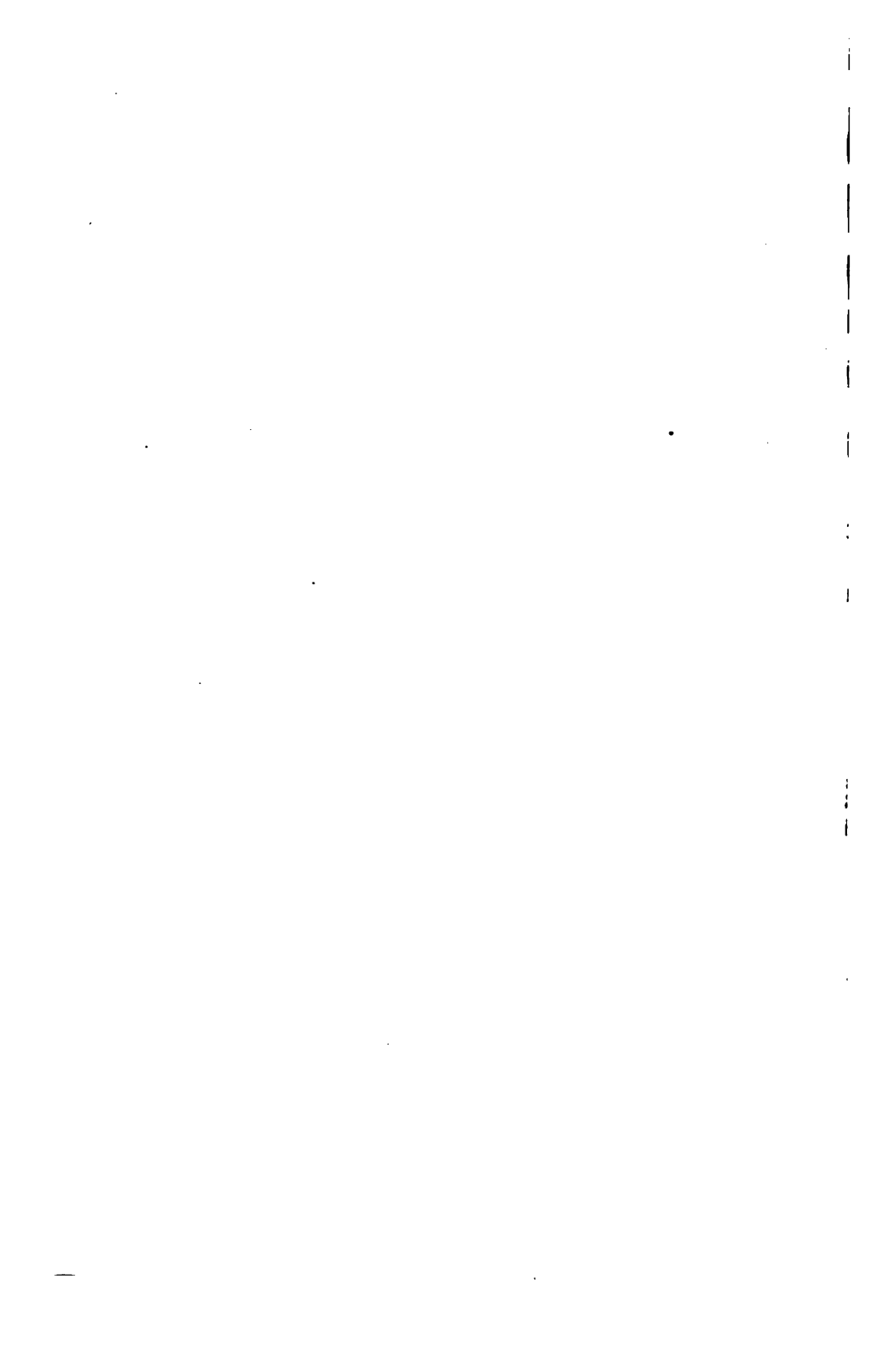


FIG. 54.—Natural Architecture of Yorkshire.

been operated upon. We all know that many of the counties of our own small islands present types of scenery peculiar to them. This is entirely due to the class and characteristics of the material of the crust out of which the scenery has been sculptured. Each kind of rock is differently affected by the influences of transition and decay, and is thereby wrought into forms specifically of characteristic

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appearance. Thus is the absorbing interest of the study of physiography enhanced by that of the equally entrancing science of geology. For example, the fundamental cause underlying the class of scenery of a district is indeed the fact that the joint-planes and natural lines of division of the various components of the earth's crust are arranged in directions peculiar to each. From this fact it obtains that Dame Nature's masons work upon each in a particular manner, and hence each becomes sculptured into its own peculiar style of architecture.





To face Appendix III.

LIGHT AND SHADE IN AN ALPINE VALLEY.

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CONCERNING AIR AND SKY

"When we attempt to grasp the conception of the boundless space in which the universe is placed, the mind of the wisest and the heart of the holiest man is humbled at the feebleness of his power to reach a height so sublime. And yet, if we ask of what is this infinite vastness composed, we shall find it is all made up of a union of particles so minute as to require the powers of the microscope."

We know not of a time and place more prepollent to arouse in the mind thoughts the purest and most solemn, than that in which, when standing—far up above the world—upon the brow of a mighty mountain, we find ourselves a midget thing in the midst of the colossal—an atom derelict upon a vast sea of mountain summits environed only by *space*. The mighty mountains may have awed us, but it is the thought of this limitless "space" which enthral us. And whilst we contemplate the infinitely great, our hearts should be filled with gratitude for the infinitely small. For to the latter are we indebted for the light and beauty with which an always beneficent Providence has endued what otherwise would have been a colourless void.

In the foregoing pages we have touched upon the fact that, were it not that our world is surrounded by an atmospheric envelope—an aerial coverture suspending above its surface transparent vapours and invisible dust—

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there could be no sky, neither could there be twilight nor colour of any kind. On the contrary, as we looked out towards the constellations of the other worlds, we should—by day as well as by night—peer into pitchy darkness.



FIG. 55. —Reflection at Twilight.

To the unscientific mind there seems always to exist a difficulty in comprehending that *the "sky" does not exist*. It may therefore be advisable to touch upon the colour of the sky—the more so because it will enable us to explain and draw analogy between it and the colour of the Swiss lakes.

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At first sight it might be thought that all that is necessary is to assume that the atmospheric envelope has a colour of its own—in other words, that the colour of air is blue, and that, therefore, light passing through a lesser thickness of it would be light blue, whilst when it passed through a greater thickness of air the colour would become dark blue. This, however, would by no means explain the facts. In the first place, we now know that the light of the sky is *reflected* light; again, we know that when the light of the sun passes through a greater thickness of air, as, for example, soon after sunrise and shortly before sunset, the colour, instead of being dark blue, is red: hence the colour of the sky cannot be due to the colour of the air. Further, as we find that the blue light of the sky is reflected light, there must be something in the atmosphere capable of giving rise to this reflection. Modern scientific investigation has shown that this something is of dual nature, in reality consisting of invisible aqueous vapour, and, as we have mentioned in the foregoing pages, dust.

We will deal with the water vapour first. Sir Isaac Newton said: "The blue of the first order, though very faint and little, may possibly be the colour of some substances, and particularly the azure colour of the skies seems to be of this order. For all vapours, when they begin to condense and coalesce into small parcels, become first of that bigness whereby such an azure is reflected, before they can constitute clouds of other colours. And so, this being the first colour which vapours begin to reflect, it ought to be the colour of the finest and most transparent skies, in which vapours are not arrived at that grossness requisite to reflect other colours, as we find it is by experience." The first question, therefore, we have to answer intelligibly is, "Why does light in passing through a greater or lesser thickness

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of our atmosphere change its colour?" To explain this we have to remember that the light of the sun—which for convenience we call white light, that being the tint with which it illuminates a piece of white paper or bleached calico—is really a mixture of a number of colours extending throughout the whole gamut of the spectrum, extending from deep red at the one end to dark blue at the other. This we know, because if we catch a ray of sunshine coming into a dark room through a small hole in the shutter, upon a wedge of glass, the light becomes decomposed into its component colours, which we see spread out in a glorious band (the spectrum) upon the white wall opposite. And we know the reason of this. It is because the sun is continually sending forth waves of different lengths, all of which travel with the same velocity* through the *ether* of space. When these waves enter our glass wedge or prism, they are retarded in their onward course; but this retardation takes place to different degrees for the waves of different lengths. The shorter waves suffer the greatest retardation, and in consequence are the most deflected from their straight course. But the shorter waves are the blue rays. Now, if the light, instead of being decomposed by means of our glass prism, passes through a great thickness of our atmosphere containing myriads of water globules, we find that it becomes split up or decomposed in a precisely similar manner. But we also know that each wave or colour is bent out of its path through a particular angle of its own; it is therefore quite easy to see that the colour assumed by the atmosphere—or, as we call it, the sky—will depend upon the particular angle at which the sun's rays pene-

* The velocity of light is about 186,000 miles in a second—so great that a ray could pass more than three times round our world in that short fraction of time.

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trate it. The precise manner in which the sun's rays become decomposed by the globules of water is fully explained in Appendix IV. in considering the formation of the rainbow.

In considering the colour of lakes, it may or may not be assumed that water has a colour—viz., blue—but that its colouring is so weak as to be quite imperceptible unless the light pass through a great depth of it. It is not, however, necessary to make this assumption, nor has it been proved that water has any colour. From what has been said concerning the decomposing and selective effect of the passage of light through aqueous vapour, we see that one and the same body may intercept one system of waves whilst allowing another set to pass on. In the case of water the set which passes on are the blue waves, and hence, as we know, the greater the distance light travels through water the bluer does it become. But though this be the case, it is obvious it will not help us to explain the magnificent deep blue colouring of Swiss lakes; for it is obvious that from the time the sun's rays have dived down beneath the surface of these lovely expanses of apparently coloured water their light would be lost to us. Perhaps it would have been better had we said "Alpine lakes," for the Italian lakes—notably that diadem, the *Lago di Garda*—are of even deeper blue than those upon the other side of the Alps. When, however, we make use of the expression "Alpine lakes," we almost divulge the secret. For these lakes are fed by glacial waters, and we have explained that by glacial motion the rocks are ground down to impalpable powder. Now, this powdered rock remains floating in the waters of these deeply-coloured lakes, and they are indebted for their beauteous colouring to the fact that, instead of the sun's rays being lost to us, they are sent back to the surface of the lake by myriad reflections from this suspended powder.

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To explain the cause of twilight and the lovely sunrise and sunset, as also the ravishing effects produced during the Alpine *afterglow*, we have only to carry our imagination to the extent of conceiving that the ocean of air, like the waters of the lakes, holds in suspension myriads upon myriads of dust particles, impalpable and invisible; and to these are ascribable not only the existence of the sky, but that of the suffused light of day.

In dealing with such recondite investigations, it is indeed fortunate that usually we can prove our speculations by

means of direct experiment. Moreover, the thesis just propounded lends itself to experimental proof in a very simple and conclusive manner. If the dust particles be the cause of light, then, logically, their absence should produce darkness. This we find to be the case, as anyone can prove for him-



FIG. 56.—Reflection from the Surface of a Calm Lake.

(To show the faithfulness of the image, the photograph is printed upside down.)

self. We have spoken of a ray of light entering a dark room through the shutters. Everybody knows that the light makes itself evident in the form of a brilliant "shaft," darting in an absolutely straight line across the room; but everybody may not know that it is revealed to us only by brightly illuminating the "motes" and dust floating in the air of the darkened room. Nor may they know that they can at once destroy this golden shaft by holding in its path a flame—as, for example, a Bunsen gas burner. If this be done, the dust in that portion of the sun's

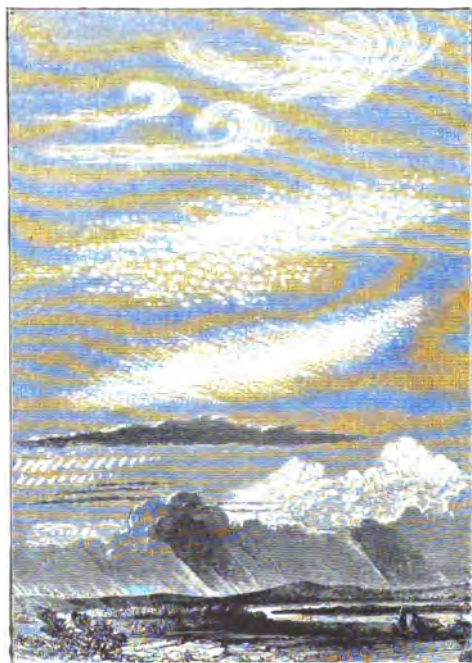
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ray will be burnt up, and the shaft will be broken in twain, the gap being demarcated by absolute darkness. The phenomenon was investigated, with his usual care and thoroughness, by the late Professor Tyndall at the Royal Institution. Tyndall made use of a bright ray from the electric light, and caused it to pass lengthwise through a long glass cylinder, filled with air of varying degrees of purity as regards dust. With the air of an ordinary room, however clean and well ventilated, the interior of the glass cylinder was beautifully illuminated. But when this air was pumped out of the cylinder, and it was again filled with air which had passed slowly through a fine gauze of intensely heated platinum wire, by which means the floating dust particles—which are mainly organic—were burnt up, then the light passed through the cylinder without illuminating its interior, and, looked at from the side, the tube appeared to be filled with a dense black cloud.

By this means it was experimentally proved, firstly, that we are indebted to the dust in our atmosphere for our daylight, and, secondly, that were the dust particles removed we should find ourselves in utter darkness. Here we have the two extremes: but the question remained to be answered, "If an appropriate number of the dust particles had been present in the tube, would a 'sky' have been formed?" This was proved in the affirmative by the simple expedient of causing the air to again pass into the glass cylinder through the heated gauze, but at such a speed that the dust particles were only partially consumed. We may picture the measure of the investigator's gratification on seeing a slight blue haze appear! As the number of the dust particles augmented, this slight blue haze increased to a pure blue equal to that of an Italian summer sky.

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Now are we in a position to understand the beneficence of the vast clouds of invisible dust which, mile after mile, hang suspended above our heads. Moreover, to appreciate the value of the meteoric dust with which our world is eternally bombarded, and the dust we saw cohering so interestingly to and flecking the white snow upon the summits of the Alps.



To face Appendix IV.

THE FORMS OF CLOUDS.

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THE RAINBOW

"When the lamp is shattered,
The light in the dust lies dead ;
When the cloud is scattered,
The rainbow's glory is shed."

SHELLEY.

"We are like evening rainbows, that at once shine and weep."—
S. T. COLERIDGE.

THE appearance of this beautiful phenomenon, long worshipped by many ancient priests and priestesses, regarded with awe and veneration, and even accepted as a miracle, is now directly referable to well-known laws in optics. The ancients said it was made up of the smiles of heaven commingling with the tears of earth. Aristotle, however, correctly attributed the phenomenon to the reflection of the sun's rays from drops of rain, and observed that a rainbow may be made from the spray from an oar ; and that in this case it becomes visible to a person who turns his back to the sun, in the same manner as in the case of the natural rainbow. We now know it to be produced by the rays of the sun falling upon spherical drops of rain-water, and being thereby refracted and reflected back to the eye, but it is certainly surprising to learn that this was not only known and

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understood three centuries ago, but that the correctness of the hypothesis was actually proved experimentally at that time. This, however, would seem to be the fact, for in the year 1600 Antonio de Dominis,* Archbishop of Spelatro, made a beautiful experiment by means of a sunbeam acting upon a glass bulb filled with fluid, and made to take the place of the raindrop. This experiment has been repeated recently by means of the oxy-hydrogen lantern, the arrangement adopted by Mr. Lewis Wright being shown in Fig. 57.

The lantern, playing the part of the sun, is placed behind a white screen, and its lenses so arranged as to project a parallel beam upon the small globe of water B, one and a half inches in diameter, supported in the clip C. A circular rainbow is thereby produced upon the screen as shown.

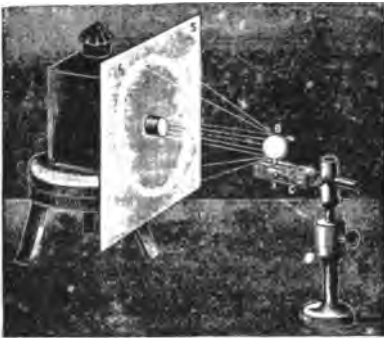


FIG. 57.—Artificial Reproduction of the Rainbow.

This is the real rainbow reversed. The explanation of the formation

of the rainbow will be understood by reference to Figs. 58 and 59, the latter showing what happens to the rays of the sun on entering and leaving the raindrops. We all know that the rainbow or iris is seen *opposite* to the sun. It is a glorious arch appearing, as we are apt to think, in the sky, but in reality upon the falling raindrops. It appears whenever the necessary conditions of a passing shower on the one side, and a clear and not too high sun on the other,

* The theory propounded by Dominis was afterwards elaborated by Descartes, and lastly perfected by Newton.

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are complied with, the latter condition explaining why rainbows are more frequently seen on summer evenings than at other times. We also all know that the bright rainbow is frequently accompanied by another larger and broader, but somewhat fainter bow outside it, and *apparently* higher up in the sky. Both the bows exhibit the full set of colours of the spectrum which we have given in their sequence in the footnote to p. 308, and it will be noted that the primary (inner) bow has its colours arranged commencing with the red upon its *outer* edge, and merging



FIG. 58.—Conditions which must obtain in order that the Rainbow may be seen.

through the spectrum into the violet upon its *inner* edge, whilst the secondary (outer) bow has the colours arranged in the inverse order. That this should be so will be understood by studying the course of the ray in the raindrop, and the effect of dispersion upon its emergence from it.

In the illustration (58) the conditions necessary for the formation of the rainbow are depicted, as also the course of the sun-ray. As has already been mentioned, the sun must be low and approximately at the back of the observer. On account of the great distance of the sun from

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us—some ninety-two millions of miles—the rays are parallel, and these are represented by S', S, S'' . After suffering refraction, reflection and dispersion, they—in their analyzed condition—will be reticulated to the eye of the observer at O . The action taking place will be more readily understood by reference to Figs. 58 and 59. We will take first the case of the real rainbow seen at g (illustration 58). The ray S is the cause of this effect. At the point of incidence, a , with the raindrop n , part of its light is reflected from the surface of the sphere, but of this we will take no note; another portion of its light enters the raindrop, the ray being bent or *refracted* in the manner shown. Passing through the raindrop, the ray strikes the

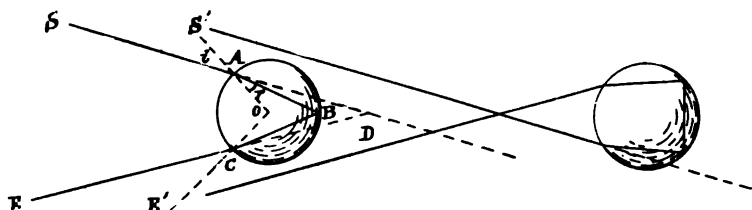


FIG. 59.—Diagram explanatory of the Formation of the Double Rainbow.

back of the sphere at b , and much of it is *reflected* backwards—exactly as if the drop had been a spherical looking-glass—the remnant of the ray emerging from the drop at the point c . Here, again, it suffers *refraction*. But, as every student of elementary science knows, the different colours of which white light is composed suffer refraction in different degrees—that is to say, some are more bendable or *refrangible* than others; the red rays are the *least* bendable, the violet ones the *most refrangible*. Hence it is clear at the point c the rays will suffer dispersion also, and thus the ray will be split up into the prismatic colours,

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and, instead of our seeing white light, we shall see coloured light.

We can also easily reason out *what* coloured light we shall see first. It will be red on account of its lesser refrangibility, for in regard to red light the angle of deviation will be $40^{\circ} 17'$, whilst for the violet it will be $42^{\circ} 2'$. So that the falling drops will first send us red rays—and we have said that the top of the bow is red—but the same drops in falling will send us other colours. We know very well that the colours will follow the sequence of the spectrum, because that chromatic *gamut* represents the degrees or ratios of bendability, or refrangibility, of the different colours. Hence the last colour to be sent to us will be the violet, and we know that violet is the colour of the lower or inner edge of the bow.

But now, it may be asked, why should the rainbow take the form of an arch—the “*arc en ciel*,” as the French term it? The word “bow” is not a particularly apposite one, because the phenomenon really takes place in the form of a circle, but we are usually prevented from seeing the complete circle by reason of the drops being destroyed on coming in contact with the ground. One often sees, however, that the rainbow is not really in the sky, but comparatively close to us, by observing that it exists nearer to us than the background of meadow or trees. We can often see through it, as through a coloured veil. Moreover, if the phenomenon be observed from the mountains the “bow” will be seen in the form of a complete circle, as it does in steam and fountain spray.

This question may be answered from what has already been said, it being easily deducible from the reasoning given; for if each colour have its own angle of deviation, as we know it to have, then it is clear that the raindrops

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exactly in front of the observer—it must not be forgotten that *each* person has his *own* rainbow—can only return the *particular colour* to him whilst they are at a *particular height*. A little thought, however, will prove to us that raindrops falling to the right and left of his line of vision *are* capable of returning the same colour of light to him, but this must of necessity take place when they have fallen *lower* than those directly in front of the observer. Hence



FIG. 60.—The Bent Oar, illustrative of how a Ray of Light is deflected on entering Water.

the latter form the crest of the arc, whilst the former, having fallen lower, form the glorious curve of ravishing splendour.

The geometrical theory of the rainbow requires a knowledge of the manner in which a ray of light, or pencil of parallel light, is refracted and reflected through a transparent sphere, and of the form of the emergent beam. Let SA (Fig. 59) be a ray striking a transparent sphere or raindrop at an incident angle i . Draw the radius OA of the

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sphere. Then the incident ray makes an angle i with OA produced. The ray AB refracted into the sphere makes an angle $OAB=r$, with the radius OA in accordance with the equation $\sin r = \sin i/\mu$.

The refracted or bent ray AB is incident on the rear surface of the drop at B . Draw the radius OB . Then the angle OBA is the angle of incidence at B . Further, since $OB=OA$, the triangle OAB is isosceles, and the angle $OBA = \text{the angle } OAB = r$. Thus, the ray AB is incident at an angle r at B , and, if BC is the corresponding reflected ray, then the angle CBO is equal to the angle $OBA = r$.

Reasoning in inverse manner, let the ray AB be incident at C on the front surface of the sphere. Draw the radius OC . Then, since $OB=OC$, the angle of incidence OCB is equal to the angle OBC , or to r . Consequently, the emergent ray CE is inclined to the radius OC (produced) at an angle i , equal to the angle of incidence of the ray SA at A . Produce the rays SA and EC to meet at D . Then the deviations produced by refraction at A , reflection at B , and refraction (thence dispersion) at C , are together equal to the angle D . This is the angle through which the ray SD (shown horizontally in Fig. 58), incident upon the raindrop at A , must be rotated about the point D in order to bring it into coincidence with the direction of the emergent ray DE .

The path of the ray (S') through the drops is shown in Fig. 59. From this the reader will understand the formation of the upper or secondary bow, and he will also be able to reason out why the colours in that are inverted.

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THE SNOW-LINE.

The snow-line is that well-defined margin we see demarcating the lower limit of perpetual snow. Below this limit the heat of summer is capable of melting all the snow falling each winter, but above it it is powerless to remove the everlasting white mantle. Surely this is sufficiently paradoxical, for the valleys are farther away from the sun than the mountain summits, and hence one would expect the snow at the top would be the more readily melted.

Many were the conjectures of the earlier physicists to account for the phenomenon; but no conclusive answer could be given until the scientist had become possessed of certain instruments of research and could employ certain modern modes of investigation. It was known that the temperature of our atmosphere becomes colder in proportion as we ascend to higher altitudes above the surface of the earth, but why this should be remained inexplicable. At a comparatively short distance up the temperature falls to freezing-point; hence the invisible aqueous vapour in the air can no longer remain as such, but passes into ice in the form of snow.

The physical phenomena and scientific principles involved in a comprehensive investigation of the subject are somewhat complex, and cannot be gone thoroughly into here. We must therefore content ourselves with a reference to the principal cause, and this we are enabled to do as a result of the laboratory experiments of that intelligent observer and intrepid student of the mountains, Professor Tyndall.

The existence of the snow-line is due principally to the peculiar and selective behaviour of the atmospheric envelope

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surrounding our world in regard to radiant heat. To put the matter very tersely, our atmosphere has the effect of permitting the *visible* heat radiation from the sun to pass freely through it to the earth's surface; but at the same time it acts as an absorbent screen to the *invisible* radiant heat, subsequently *leaving* the earth's surface. To understand this, we must remember that all bodies are radiating heat, the one to the other, in proportion to their respective temperatures. If we stand before a hot stove, the stove radiates heat to us, but we also radiate heat to it; the quantity of heat, however, which the stove radiates being greater than that we radiate, we gain more than we lose, and are in consequence warmed. A similar transference takes place if we stand near a block of ice: the block radiates heat to us, and we give off heat to it, but, the heat received by us being less than we give out, we become chilled. In like manner heat from the sun is radiated to us by day, and both by day and by night our earth radiates heat into space as against the sun, moon, and stars. The quantity of heat received by us by day, however, being greater than the quantity lost, the earth becomes warmed; but by night the earth radiates out more heat than she receives from the moon and stars, and hence she is cooled. One must not confuse this *radiation* through the *ether* of space with heat *conduction* by the *atmospheric envelope*, and we must further note the fact that the heat of the sun comes to us principally as luminous heat. This is absorbed for a time in the crust of the earth, and then reissues into space as *obscure* heat.

We have pointed out that the emanations from a luminous source are of a composite nature, comprising luminous rays and obscure rays; for example, 90 per cent. of the rays emanating from an oil flame are obscure, whilst only 1 per

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cent. of the rays given out by an alcohol flame are luminous. Now, the different classes of rays are acted upon quite differently by absorbent media intervening between the radiating bodies. For example, in regard to luminous emanation, a vast portion of the sun's rays are able to pass instantaneously through a great thickness of water; yet if these be converged even by means of a water lens, or, indeed, an ice lens, upon gunpowder, the latter will be ignited. On the other hand, obscure rays, such as those radiating outwards from the earth, are all absorbed by a thin film or layer of water, though it be less than one-twentieth of an inch in thickness.

From this we see that the *character* of the heat arriving from the sun, and subsequently returned towards it, is entirely changed, and that the two classes of heat—luminous and obscure—are affected quite differently in their passage through solids and liquids. This matter was most carefully investigated by means of an exceedingly delicate instrument, known as the thermopile, by Melloni, but the subtle question remaining to be answered was, “Do gaseous bodies act in a similar manner upon luminous and obscure heat?” To answer this, Tyndall—who felt it absolutely necessary in connection with his studies upon glaciers—entered upon a series of beautiful and delicate experiments, and these gave response in the affirmative. He found that gases—in other words, our atmosphere—intercept the *obscure* rays much more readily and completely than the *luminous* ones; hence it follows that, whilst the rays of the sun penetrate our atmosphere with freedom, the change they undergo whilst warming the earth deprives them in a large measure of this power of penetration. To use Tyndall's own words, “They can reach the earth, but *they cannot get back*. Thus, the atmosphere acts the part of a

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ratchet-wheel in mechanics: it allows of motion in one direction, but prevents it in the other."

In order that the reader may thoroughly understand this, it is necessary for him to disabuse his mind—and this appears to be a great difficulty with many people—of the thought that air is warmed by the passage of heat through it. This is not the case. It is only when the heat impinges upon a solid that heating takes place. For example, on the summit of a high mountain we find our face and hands becoming blistered by the fierceness of the sun's rays, yet if we measure with a thermometer the temperature of the air—taking care to shield the bulb of our thermometer from the direct impact of the rays—we shall find the air has not been warmed by the passage of those fierce rays through it. Again, in the warming of our rooms it is often erroneously assumed that the heat radiating from the incandescing coal warms the air of the room. This, however, is not the case, the warming of the air being effected by conduction from the heated walls, furniture, etc., which have been warmed by impact of the rays upon them. The obscure rays, however, such, for example, as those given out by the hot metal of the grate, are absorbed by, and hence warm, the air. The differentiation as between the luminous and obscure rays is shown in a familiar manner in using glass fire-screens. In that case, as we know, the luminous rays—those of shorter wave-length—pass through without loss, whilst those of longer wave-length become absorbed on impact and passage through the glass, and their heat transferred to the air by conduction; so that, whilst the user enjoys the luminous rays from the fire, she is in a large measure shielded from the heat rays.

From this, it is hoped, will be understood how it comes

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about that, whilst the air in the valleys is warm, and flowers and vegetation thrive, it remains of Arctic coldness a mile above them. We have said that to take into account all the factors and principles involved would result in a long and complex consideration of the interesting phenomenon, and hence reference to the principal cause must suffice. It might reasonably be asked, seeing that our dwelling-rooms become hottest in their upper regions, Why should not the warmer air of the valleys ascend and warm the upper strata? The reply is that the warmer air of the earth's surface *does* ascend into the upper regions of the atmosphere, but it *does not* raise the temperature. To explain this it is only necessary to mention that the density of the atmospheric envelope at the earth's surface is very great, its weight causing it to press upon every inch of surface with a pressure of "one atmosphere," viz., 15 pounds; but from the earth's surface upwards its density diminishes until it ceases to be appreciable, and, indeed, to exist. This being the case, it is obvious that directly the warmer air *commences to ascend* it at the same time *commences to expand*, and immediately becomes colder; for the quantity of heat it has imbibed is attenuated by the greater space it has to occupy, and a corresponding fall of temperature is the result.

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CLOUDS.

The expansion of air containing invisible aqueous vapour is the principal cause of clouds. There is, perhaps, nothing at once more lovely and more wonderful than the mutations of the clouds. And when we watch their formation in a perfectly transparent atmosphere and beneath an absolutely clear sky, where all appears absolutely serene and motionless, in an incredibly short space of time coming into being and then growing into protean masses, each subject to incessant change and performing the most entrancing mutation of form, it were excusable to deem such phenomena to take place without definite cause, and, moreover, to assume that the flocculent masses should exist without form or order.

Such, however, is not the case. The formation of clouds is amenable to, and governed by, definite law, whilst even the different forms and "cloud shapes" have been classified.

We give, in our illustration facing this Appendix, the form and appearance of typical clouds, the names of which may be found in works upon meteorology. Not alone are the forms of clouds recognisable by the initiated, but it has been ascertained that particular clouds form at particular altitudes. Modern research has lent additional interest to the discovery that, to produce cloud, dust must be present in the atmosphere—microscopic though these nebulous nuclei need be—perhaps the latest amplification of research in this domain being the discovery that remarkable effects, in regard to cloud formation, result from the influence exerted upon the nuclei by that occult radiation popularly known as X rays. In other words, it has recently been demonstrated that the forms of clouds are greatly dependent upon electrical influence.

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Research has been made both within the laboratory and in the open air at high altitudes. In the latter it was at first confined to observations—necessarily made very occasionally—by means of balloons; recently, however, scientific kite-flying has enabled observations and research to be carried on both more expeditiously and more economically. By this means aerial research has been made at altitudes up to 8,000 feet, and valuable corroboration as well as additional knowledge has been thereby obtained. In regard to such corroboration, it was found—by means of a self-registering thermograph carried by the kite—that the decrease of temperature with elevation is less in free air than where it is subject to interfering causes due to the proximity of land. Not only have the various *strata* of air been investigated, but the layers of dry air alternating with very damp or “saturated” air have been localized.

We drew attention at the outset to the fact that the infinitely great is dependent upon, and, indeed, built up of, the infinitely small, and we trust that the various remarks we have ventured to make may have served to emphasize the fact that this truism applies in every department of Nature; moreover that, if we but use our eyes and our brains, exquisite pleasure is derivable from any and every of our varied surroundings. “From every natural fact,” says Tyndall, “invisible relations radiate, the apprehension of which imparts a measure of delight; and there is a store of pleasure of this kind ever at hand for those who have the capacity to turn natural appearances to account.” That a perusal of the foregoing pages may induce readers profitably to “turn natural appearances to account,” and thus minister to their own pleasures, is the sincere wish of the author.

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